DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

METAL FINISHING

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by Palmer H. Langdon, 1868-1935

JUNE, 1948 VOLUME 46 • NUMBER 6

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COMING SOON

Results of a thorough study of the causes of peeling and flaking of electrodeposited metals, including the effect of surface conditions prior to plating.

A discussion of several practical methods for producing corrosion resistant chrome surfaces on steel parts thru diffusion of chromium into the surface at elevated temperatures.

Automatic polishing and buffing of automobile trim and molding at the plant of a leading manufacturer.

Another of the important series of discussions on the effect of the physical properties of fluids on the electroplating process.

A review of methods for determining "throwing power" and their significance.

Editorial and Business Staff

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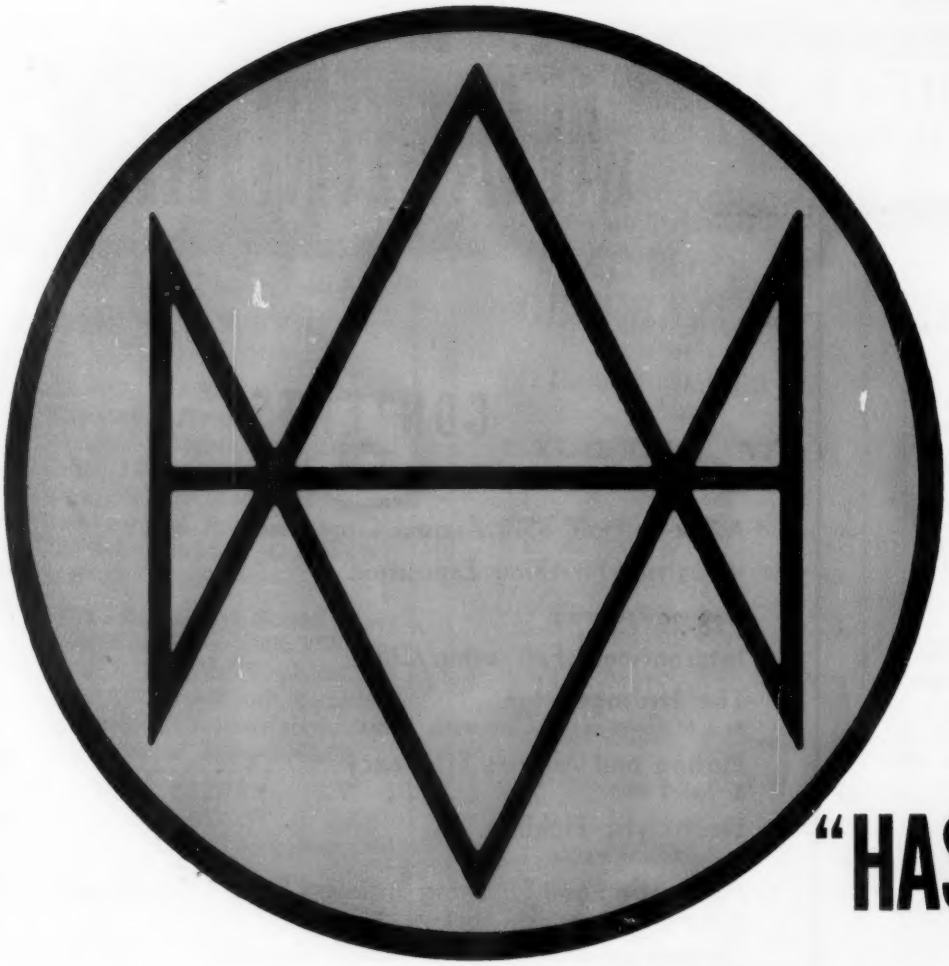

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Visit H-VW-M Headquarters, Ambassador Hotel as well as H-VW-M Exhibit, Booth No. 5, Convention Hall, at the A. E. S. Convention, Atlantic City, N. J., June 28—July 1, 1948.

ESTABLISHED 1903

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

VOLUME 46 • NUMBER 6 • JUNE 1948

METAL FINISHING

Convention and Exposition Section

American Electroplaters' Society 35th Annual Convention

Ambassador Hotel Atlantic City

June 28-29-30 July 1

★

In the following special blue pages you will find

1—A complete program of technical sessions, business meetings, and social events.

2—A list of exhibitors of equipment and supplies, with booth numbers, products to be on display, and names of the representatives who will be in attendance.

3—A Ladies program, listing the various events that have been planned to keep the ladies occupied and entertained throughout the convention.

4—A program of events of special interest to members of the International Fellowship Club and their guests.

5—Photographs of National Officers, Newark Branch Officers, Committee Chairmen, and other notables who will play an important part in the various affairs.

★

FINISHING PUBLICATIONS, INC.
FOUNDED 1903 AS METAL INDUSTRY PUBLISHING CO., INC.
11 WEST FORTY-SECOND STREET, NEW YORK 18, NEW YORK

BOOTH 29

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METAL FINISHING
GUIDEBOOK-DIRECTORY for the METAL FINISHING INDUSTRIES

ORGANIC FINISHING
GUIDEBOOK-DIRECTORY ISSUE OF ORGANIC FINISHING

A. E. S. To Hold 35th Annual Convention

ATLANTIC CITY, JUNE 28—JULY 1

Official Program

SUNDAY, JUNE 27
3:00 p.m.

Registration—Hotel Ambassador.
Registration Fee—$10.00.

This entitles registrant to a book of tickets that can be used for all functions and activities during the Convention. Registrants need not be members of the American Electroplaters' Society.

MONDAY, JUNE 28
8:00 a.m.

Registration—Hotel Ambassador.

9:30 a.m.—12:00 noon

Opening Session—Convention Hall Ballroom.
Invocation—Reverend *Frank C. Mesle*, Member Rochester Branch.
Welcome to Delegates, Members and Guests —*Horace H. Smith*, General Convention Chairman.
Welcome to Atlantic City—Mayor of Atlantic City.
Greetings from Newark Branch A.E.S.—*Zachary Irenas*, Newark Branch President.
First Business Session of the A.E.S.—*Kenneth M. Huston*, Supreme President 1947-1948 presiding.

12:30 p.m.

International Fellowship Club — Annual Luncheon. (for Suppliers and their Representatives ONLY).

Following the luncheon there will be an election of Fellowship Club officers for the coming year and a discussion of arrangements for the OPEN HOUSE.

Supreme President

Kenneth M. Huston

2:00 p.m.—4:30 p.m.

FIRST EDUCATIONAL SESSION — Convention Hall Ballroom (2nd floor), *William Geissman*, Technical Chairman.
Industrial Electropolishing — Charles L. Faust, Battelle Memorial Institute.
Electropolishing Silver in Cyanide Solutions Daniel Gray, Oneida, Ltd.
Diaphragm Tanks to Eliminate Roughness in Copper Plating—R. H. McCahan and C. E. MacKinnon, E. I. Du Pont de Nemours & Co.
Oxidation of Trivalent Chromium in Chromic Acid Plating Baths—Robert Seegmiller and Vernon Lamb, National Bureau of Standards.

8:30 p.m.

OPEN HOUSE—Sponsored by the International Fellowship Club.
Renaissance Ballroom, Hotel Ambassador.
Dancing, Buffet Lunch, Refreshments.
Presentation of Special Awards.

All registrants, Men and Women, are cordially invited to attend. A ticket for this event is included in your registration booklet.

The OPEN HOUSE is held on the first night of the Convention to provide an opportunity for all registrants to become acquainted. It is sponsored by the International Fellowship Club, an organization formed to create goodwill in the Metal Finishing Industry. Membership in the Club consists of manufacturers, supply houses and their representatives serving the Metal Finishing Industry and it is through their generosity that the OPEN HOUSE is made possible. A program including a list of Contributors will be distributed.

TUESDAY, JUNE 29
8:00 a.m.

Registration—Hotel Ambassador.

8:00 a.m.

Breakfast, A.E.S. Branch Secretaries, Hotel Ambassador, Room 125.

9:30 a.m.—12:00 noon

SECOND EDUCATIONAL SESSION—Convention Hall Ballroom (2nd floor), *Leonard Weeg*, Technical Chairman.
Description, Design and Production Costs of Conveyorized Spray Finishing System—E. Paul Schwartz, L. C. Smith-Corona Typewriter Corp.

Officers of the Supreme Society 1947-1948

A. E. S. 1948

Sam S. Johnston
First Vice-President

A. W. Logozzo
Second Vice-President

W. J. Neill
Third Vice-President

A. K. Graham
Executive Secretary

F. K. Savage
Past President

The Electroplaters Metals of the Future—F. A. Lowenheim, Metal and Thermit Corp.

The Importance of Acid Ratio in the Phosphatization of Steel—Nelson F. Murphy and Michael A. Streicher, Dept. of Chemical Engineering, Virginia Polytechnic Institute.

Metal Cleaning—George B. Hogaboom, Consultant.

12:00 noon

International Fellowship Club Golf Tournament—Atlantic City Country Club, Northfield, New Jersey, *Joseph J. Duffy*, Chairman.

Transportation should be arranged through the Golf Committee.

Attractive prizes will be awarded. All handicap groups have a chance to win. An informal luncheon will be served at the Club between 12:00 Noon and 1:30 P.M. Tee-off time is between 1:00 and 2:00 P.M. Bring your sticks and shoes. A limited number of rental sets will be available at the Club.

Evening

Open.

8:00 p.m.

Research Committee Meeting—Hotel Ambassador, Room 106.

WEDNESDAY, JUNE 30

8:00 a.m.

Registration—Hotel Ambassador.

9:30 a.m.—12:00 noon

THIRD EDUCATIONAL SESSION—Convention Hall Ballroom (2nd floor), *George P. Swift*, Technical Chairman.

A Circulating Electrolyte Cell for Strip Plating Evaluation—R. A. Dimon, Carnegie-Illinois Steel Corp.

Bright Barrel Plating of Nickel and Zinc—Leonard A. Chesworth, United-Carr Fastener Corp.

Plating Copper-Zinc Alloys—A. Kenneth Graham; Graham, Crowley and Associates.

The Deposition of Metals on Plastics Employing Reduced Copper Films—Harold Narcus, Electrochemical Industries, Inc.

12:00 noon

Job Platers' Luncheon.

2:00 p.m.—4:30 p.m.

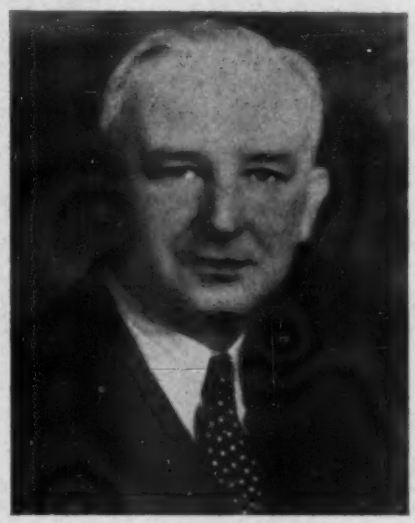
FOURTH EDUCATIONAL SESSION—Convention Hall Ballroom (2nd floor), *Howard Woodward*, Technical Chairman.

Judging the Quality of Plated Parts—William M. Philips and F. L. Clifton, General Motors Corp.

Practical Methods of Cost Finding and Estimating on Metal Finishes—Adolph Bregman, Consultant.

The Spiral Contractometer, a New Instrument of the Measurement of Stress in

Convention Chairman



Horace H. Smith
Newark Branch, A. E. S.

Electrodeposits—Abner Brenner and Seymour Senderoff, National Bureau of Standards.

Engineering Planning in the Plating Room—S. M. Martin, United Chromium, Inc.

8:00 p.m.

SPECIAL BUSINESS SESSION, AES—Convention Hall Ballroom (2nd floor), *Kenneth M. Huston*, presiding.

Preliminary discussion of newly Proposed Constitution and Proposed Amendment by Newark Branch.

THURSDAY, JULY 1

8:00 a.m.

Registration—Hotel Ambassador.

8:00 a.m.

RESEARCH COMMITTEE BREAKFAST—Room 125, Hotel Ambassador.

9:30 a.m.

FIFTH EDUCATIONAL SESSION—RESEARCH REPORTS—Convention Hall Ballroom (2nd floor), *Louis Weisberg*, Technical Chairman.

Project 5—*Some Effects of Copper as an Impurity in Nickel Plating Solutions and its Effect on the Salt Spray Resistance of Nickel and Chromium Deposits on Steel.* D. T. Ewing and Robert Rominski.

Project 6—*Determination of the Porosity and Corrodibility of Electrolytic Metal Foils.* N. Thon and D. K. Kelemen.

Project 7—*The Effect of Internal Stress on Thickness Determination by the Jet Method.* Harold J. Read

Project 9—*Physical Properties of Nickel Deposits.* Abner Brenner and Charles W. Jennings.

2:00 p.m.

FINAL BUSINESS SESSION—Convention Hall Ballroom (2nd floor), *Kenneth M. Huston*, presiding.

7:00 p.m.—2:00 a.m.

ANNUAL A.E.S. BANQUET—Renaissance Ballroom, Hotel Ambassador. Dinner—Community Singing—Awards. Entertainment—Continuous Music for Dancing.

BRANCH EXHIBITS OF PLATED WARE

Once a year the plater's talents are brought to public attention in the form of an organized and clearly described exhibition of plated ware. All Branches of the Society compete for the honor of having the best exhibit. Branch exhibits will be displayed in the Convention Hall, where is also held the Industrial Exposition. Having seen the equipment required for metal finishing, the exhibits will show the ultimate end results.

Mr. Louis J. Donroe is the chairman of the Branch Exhibits Committee.

Officers of the Newark Branch—Convention Hosts for 1948

A·E·S· 1948

Zachary Irenas
President

Robert Herwig
First Vice-President

Sam Frey
Recording Secretary

E. Bowerman
Librarian

A. E. Howe
Assistant Librarian

INDUSTRIAL FINISHING EXPOSITION

Following is a complete listing of exhibitors of equipment and supplies, together with the booth numbers and the names of persons who will be in attendance at the booths during the Industrial Finishing Exposition.

Acme Mfg. Co. 52-53-54
1645 Howard St. Detroit, Mich.
Automatic and semi-automatic polishing and buffing equipment.
Glen A. Carlson & Geo. R. Carlson.

Allied Research Products, Inc. 131
4004 E. Monument St. Baltimore 5, Md.
Iridited parts.
H. C. Irvin, A. L. Poe.

Almco Div. of Queen Stove Works, Inc. 69
902-910 Marshall Ave. Albert Lea, Minn.
Deburring and finishing barrels, hoisting and separating units, chips and supplies.
Scott A. Silliman.

Alpha Metals, Inc. 16
363 Hudson Ave. Brooklyn 1, N. Y.
Special lead anodes for chrome plating.
Harold Shonberg and *Martin A. Boyle.*

Alsop Engineering Corp. 51
Milldale, Conn.
Filters of all types, models and sizes for plating solutions and industrial oils.
S. Alsop, C. E. Crowley, W. W. Freystedt, J. J. O'Shea, S. Alsop, Jr.

American Buff Co. 170-171
2414 S. LaSalle St.. Chicago 16, Ill.
Buffs and polishing wheels. Operating plating tanks and polishing lathes.
Ben P. Sax, Harry Pink, Marvin Radom, Edward W. Hoyle, Ernest Reichenberg.

American Chemical Paint Co. 106
Ambler, Pa.
Paint bonding chemicals, phosphating chemicals, pickling inhibitors, cleaning compounds.
F. P. Spruance, Wm. Boyer, R. O. Bailey, F. P. Spruance, Jr., Joseph Mazia, James Thirsk.

Industrial Finishing Exposition Chairman

George Wagner
Newark Branch

American Instrument Co., Inc. 17
8010 Georgia Ave. Silver Spring, Md.
Magne-gage, Filmeter, pH meters, electric heaters and controls.
L. R. Heiss.

Automotive Rubber Co., Inc. 154
8601 Epworth Blvd. Detroit, Mich.
Rubber linings, coatings, all types of rubber equipment for plating, cleaning.
R. L. Redmond, T. G. Meulenberg, C. R. Petoskey, F. D. Wressell, W. C. Enright.

Bart-Messing Corp. 119-120
45 Morgan Ave. Brooklyn 6, N. Y.
Rectifiers of all types and plating supplies.
E. R. Redlhammer, Morris Messing, Robert Corey, S. O. Bart, Ed Rinker, Ben Flug, S. Bass.

Beacon Supply Co. 15
110 Marginal St. Chelsea 50, Mass.
Buffing wheels.
Max Feinberg, A. L. Farnham, R. S. Deacon.

Behr-Manning Corp. 155-156
Troy, N. Y.
Grinding and polishing with coated abrasive belts.
L. K. Brooks, T. Trobridge, M. I. Jackson, A. F. Lenhardt, K. T. Obeck.

Belke Mfg. Co. 38-39
947 N. Cicero Ave. Chicago 51, Ill.
Plating racks, electric carboy acid pump, automatic transfer machines, rheostats, rack insulating demonstration, tank magnets, plating barrels.
Wm. E. Belke, Ralph Belke, Harvie Johnson, Roy Johnson, Edward Stanek, Raymond Kotz, Michael Nakashima.

G. S. Blakeslee Co. 162-163
19th St. and 52nd Ave. Chicago 50, Ill.
Cleaning and degreasing machinery units, solvents.
R. B. Thompson, I. F. Snow, P. H. Johnson, R. Kendall, John Potye.

Buckingham Products Corp. ..179-180
14100 Fullerton Ave. Detroit 27, Mich.
Buffs and compositions.
H. J. Patterson, J. R. Valarance, R. M. Buckingham, L. M. Ring, L. Winans, J. Davis, J. B. Lyon.

The Chemical Corp. 116
54 Waltham Ave. Springfield, Mass.
Zinc Bright Dip and Nickel Stripper.
K. P. Bellinger, B. H. Gardner, H. Hancock, W. N. Lindsay, L. Arsenault.

Chromium Engineers, Inc. 41
2636 S. Michigan Ave. Chicago, Ill.
Chromium plating process.
Paul B. Thomsen.

Commercial Filters Corp. 166
A & W 3rd St. Boston 27, Mass.
Complete line of filters for continuous filtration.

Chairmen of Committees for Annual Convention

A·E·S 1948

John Gumm
Registration

George Reuter
Banquet

William Bruhns
Publicity

Paul Oldam
Program

E. W. Sherburne, J. V. Calhoun, A. H. Forster, R. Schadler, W. D. Stapp, C. F. Wagner, H. C. Corwin, E. J. Stanley.

Co-operative Industries, Inc. 151
100 Oakdale Rd. Chester, N. J.
Filters for plating solutions.
V. C. Bonardel.

Crown Rheostat & Supply Co. ...60-61
3465 N. Kimball Ave. Chicago 18, Ill.
Electroplating equipment and supplies.
E. Huenerfauth, F. P. Green, C. E. Clindinin.

Darco Corp. 27
60 E. 42nd St. N. Y. 17, N. Y.
Activated carbon for purifying plating solutions.
W. A. Helbig, E. W. Harris.

Detrex Corp. 67-68
P.O. Box 501, Detroit 32, Mich.
Cleaning and degreasing machinery, solvents, drying equipment, single stage spray washing machine.
W. F. Newbery, L. Camel, G. W Walter, S. A. Harris, J. J. Kearney, Dr. W. L. MacCracken, A. D. Cabot.

The Diversey Corp. 30-31
53 W. Jackson Blvd. Chicago 4, Ill.
Metal cleaners all types, particular emphasis on a recently developed non-caustic soak tank cleaner.
B. B. Button, D. F. Seymour, R. J. Stell, R. L. Shannon, L. C. Hesoun, C. G. Smith, L. J. Moyes, F. C. Wagner, W. Laletin and *A. J. Wurster.*

Divine Bros. Corp. 25-26
200 Seward Ave. Utica 1, N. Y.
Buffing wheels, polishing wheels, buffing and polishing machinery.
R. L. Klaas, E. L. Johnson, C. J. Lamb, A. M. Brown, W. C. Beddoe.

Duggan Masking Devices 35
2030 W. Fort St. Detroit 16, Mich.
Plating racks and selective plating and painting masks.
David Riseman, U. C. Jones.

Duluth Buff Co. 141
2420 S. LaSalle St. Chicago 16, Ill.
Buffs and polishing wheels.
Morris Katz, Murray Paley.

Electric Products Co. 36-37
1725 Clarkstone Rd. Cleveland 12, O.
Motor generators.
Gordon J. Berry, R. J. Pack, C. L. Leaf, Rob't G. Redhead.

Enthone Inc. 22
442 Elm St. New Haven 2, Conn.
Processes for cleaning, coloring, and blackening of metals.
Dr. Walter R. Meyer, J. F. Buckman, C. C. Helmle, J. J. Martin, H. M. Goldman, W. R. Porter, Steven Brown, Derick Hartshorn, Austin Fletcher, Raymond Goral, A. H. Sanders.

Formax Mfg. Corp. 122
12934 Evergreen Detroit 23, Mich.
Buffs, compositions and supplies, contact wheels, backstand idlers.
H. J. McAleer, J. J. McAleer, E. W. McAleer, E. D. McAleer.

General Chemical Div., Allied Chemical & Dye Corp. 40
40 Rector St. N. Y. 6, N. Y.
Plating chemicals.
A. E. Carlson, C. Struyck, S. E. Hoddeson.

General Electric Co. 12-13
1285 Boston Ave. Bridgeport, Conn.
Electroplating rectifiers, tungar and metallic.
N. A. Searles, G. C. Ruckel, D. M. Daley, R. D. Link, E. R. Broughel, R. V. Dawney, R. D. Amsdem and *I. A. Lee.*

Walter C. Gold, Inc. 177-178
216 N. Front St. Philadelphia, Pa.
Plating supplies.
J. E. Griffiths.

W. Green Electric Co., Inc. 63
130 Cedar St. New York 6, N. Y.
Rectifiers.
L. W. Reinkin, E. I. Huppert, J. D. Trehy.

Frederick Gumm Chemical Co., Inc. 132-133
538 Forest St. Kearny, N. J.
Compounds for metal finishing; Satin Dip for aluminum; Burring processes.
Fred Gumm, C. R. Percival, R. Sizelove, R. J. Doucette, J. R. Gumm, A. S. Kohler.

Hammond Machinery Builders, Inc. 142-143-144
1600 Douglas Ave. Kalamazoo, Mich.
Polishing equipment, automatic buffing equipment, back stand idlers, single and double spindle lathes, abrasive belts.
L. Hammond, H. J. Kingsbury, S. H. Miller, R. M. Bell, M. Bass, V. Shay.

Hanson-Van Winkle Munning Co. ...5
Matawan, N. J.
Full-automatic plating conveyor in operation. Exhibit of parts plated in HVWM processes.
VanWinkle Todd, Louis M. Hague, John A. Bauer, Myron B. Diggin, Robert M. Norton.

Haveg Corp. 118
Newark, Del.
Plating and pickling tanks of plastic compounds, fans, ducts, hoods, pipe and fittings, pumps, filter press plates and insulating materials.
G. B. Allen, J. W. Carrow, H. B. Haney, C. R. Runk.

R. O. Hull Co. Inc. 45
1279 W. 3rd St. Cleveland, Ohio.
Testing equipment.
Dick Hull.

Industrial Electroplating Co., Inc...11
219 W. Vermont St. Indianapolis 4, Ind.
Fume separator unit in operation, Dust.
William Niehaus, Carl Niehaus.

Industrial Filter & Pump Mfg. Co...65
1621-39 W. Carroll Ave. Chicago 12, Ill.
Rubber lined tanks, filter units, working display of filtration system.
John R. Miller, Harold W. Faint, Morton VanLoan, J. F. Brossart, Ralph E. Liedberg.

International Nickel Co. 79-80-81
67 Wall St. New York, N. Y.
Testing equipment for electroplating.
L. W. Barber, George Black, Robert J. McKay, Walter H. Prine, Clarence Sample.

Jackson Buff Co. 102-103
21-03 41st Ave. Long Island City 1, N.Y.
Ventilated buffs.
L. W. MacFarland, L. F. Sternal.

Committee Chairmen for Annual Convention

A·E·S 1948

John DeVries
Co-Chairman

Howard Cobb
Exposition

Louis Donroe
Branch Exhibits

Myron Diggin
Educational

Kocour Co. 18
4800 S. St. Louis Ave. Chicago, Ill.
Analytical test sets and buffing compositions.
C. Kocour, O. Kocour.

LaSalco, Inc. 181-182
2818 LaSalle St. St. Louis 4, Mo.
Plating equipment and supplies. Full automatic plating conveyor.
Burt Daw, Herman Struckhoff, A. G. Bignall.

Lea Mfg. Co. 33-34
16 Cherry Ave., Waterbury 86, Conn.
Lea compounds for metal polishing and finishing.
Robt. S. Leather, Earle W. Couch, Richard P. Crane, Henry L. Kellner and *Ellsworth T. Candee.*

Chas. F. L'Hommedieu & Sons Co...55
4521 Ogden Ave. Chicago 23, Ill.
Polishing lathes, plating barrels, tank rheostats.
Chas. B. Little, A. W. L'Hommedieu, Mr. Brown, H. M. Writer and *O. M. Shoe.*

Magnaflux Corp. 126
5900 Northwest Highway, Chicago 31, Ill.
Electrical equipment.
W. E. Thomas.

Magnus Chemical Co., Inc. ...158-159
Dif Bldg. Garwood, N. J.
Cleaners and cleaning machines.
R. D. Kreie.

Matchless Metal Polish Co. ...152-153
840 W. 49th Place Chicago, Ill.
Polishing lathes with backstand idlers. Buffs.
Clarence Ellingson, William Lawrence, George Niederst, J. LeRette, H. S. Kelshaw.

Midwestern Mfg. Corp. 172
175 Fifth Ave. New York 10, N. Y.
Joint exhibit with Optimus Equipment Co. For those in attendance refer to Optimus listing.

Minnesota Mining & Mfg. Co. 70
900 Fauquier Ave. Saint Paul 6, Minn.
Working exhibit of grinding and polishing with coated abrasive belts.
A. H. Butz, S. L. Johnson, F. C. Zoccola, D. G. Sutliff, R. K. Grinden, F. A. Schraut, W. E. Dent.

Munning and Munning, Inc. 63-64
202-208 Emmett St. Newark, N. J.
Tumbling barrels, plating barrels, glue stands, agitators, buffing compounds.
P. P. Munning, A. P. Munning, J. A. Munning, W. W. McCord, R. T. Gore, W. J. Winward, B. M. Fletcher.

Nelson Chemical Corp. 149
12345 Schaefer Highway Detroit 27, Mich.
Polishing cements and accessories.
M. Nelson.

Oakite Products, Inc. 127-128
22 Thames St. New York 6, N. Y.
Surface preparation materials, emulsion solvent cleaners.
G. Lux, M. Mahr, D. Clarin, J. Basch, J. Hayes, E. Wolff, D. Clark, J. Hite, B. Fay, J. Todd, J. DeVries, H. Jacques.

Optimus Equipment Co. 4
1 Water St. Matawan, N. J.
Joint exhibit with Midwestern Mfg. Co. Vapor degreasers, washing and drying equipment.
M. Jaffa, A. T. Baldwin, W. F. Fidelius, H. Schroeder, J. Hersh.

Paper Novelty Mfg. Co. 121
505 Carroll St. Brooklyn, N. Y.
Die cut masking tapes with removable backings.
Millard Pretzfelder.

Pennsylvania Salt Mfg. Co. ...136-137
1000 Widener Bldg. Phila. 7, Pa.
Metal cleaners, acid-proof cements, corrosion resistant paints.
W. B. Drake, J. J. Duffy, A. H. Clem, P. C. Staples, R. R. Pierce, V. A. Curll, W. H. Hennessy, H. F. McIntyre, W. D. Wilson.

Plating Products Co. 24
352 Mulberry St. Newark 2, N. J.
Electroplating and polishing equipment and supplies.
M. C. Hoy, V. Trovato, G. Reuter, Jr., S. E. Payson, C. B. Murphy.

Porter-Cable Machine Co. 129-130
1714 N. Salina St. Syracuse 8, N. Y.
Abrasive belt grinding equipment and backstand idlers.
H. L. Ramsay, D. M. Lyon, F. Burroughs, P. Hardman, D. Turner, K. O. Ditmars, G. W. Matson, L. M. Harvey.

Republic Industries, Inc. 49
1040 W. Fort St. Detroit, Mich.
Buffing and polishing wheels.
J. J. Marx, Edwin A. Wolf, Jr.

Reynolds-Robson Supply Co. 157
2213-21 W. Glenwood Ave. Phila. 32, Pa.
W. A. Reynolds, D. R. Robson, C. E. Boerckel, T. Morgan, C. J. Davoli.

James H. Rhodes & Co. 28
157 W. Hubbard St. Chicago 10, Ill.
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Lincoln Kneebone, John Marr, John McCutchen, A. N. Sudduth.

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Centrifugal lacquer machine and enameler.
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Filtration equipment.
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Plating, polishing, anodizing racks.
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Filters, flexible metal tubing.
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1420 W. Lafayette Blvd. Detroit 16, Mich.
Control equipment and regulators all types, steam traps.
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P. O. Box 289 Red Bank, N. J.

U. S. Stoneware Co. 71-72-73
5300 E. Talmadge Ave. Akron, Ohio.
Complete line of electroplating equipment, tanks, corrosion resistant materials, stop-offs, lead anodes, acid proof paints, rubber tank linings.
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Wagner Bros., Inc. 134-135
400 Midland Ave. Detroit 3, Mich.
Rectifiers and zinc anodes.
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Cleaning materials used in pickling and bright dipping.
G. E. Willey, E. P. Frankel, T. F. O'Brien, E. W. Coogan, F. A. Miller.

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Plating barrel.
E. Collick.

Ladies' Program

Mrs. Regina Munning
Chairlady

The Ladies' Committee for the 35th Annual Convention of the American Electroplaters' Society extends a warm welcome to you who are our guests in Atlantic City this year. A program has been prepared for your pleasure, diversion and entertainment which will keep you occupied and interested.

SUNDAY, JUNE 27

3:00 p.m.

Registration—Upper Lounge, Hotel Ambassador. Registration Fee $10.00.

This entitles registrant to a book of tickets that can be used for all functions and activities during the Convention. Registrants need not be members of the American Electroplaters' Society.

MONDAY, JUNE 28

8:00 a.m.

Registration—Hotel Ambassador.

3:00 p.m. to 5:00 p.m.

Tea will be served in the beautiful and spacious Upper Lounge of the Hotel Ambassador.

Mrs. Jennie Wagner
Secretary

8:30 p.m.

OPEN HOUSE—Under the auspices of the International Fellowship Club.

Rennaissance Ballroom, Hotel Ambassador.

Dancing, Buffet Lunch, Refreshments.

All registrants are invited to attend.

TUESDAY, JUNE 29

8:00 a.m.

Registration—Hotel Ambassador.

The morning is open for your choice of activities.

1:00 p.m.

Aunt Ella's Society Luncheon Party—Sponsored by Oakite Products, Inc.

Embassy Salon, Hotel Ambassador.

D. X. Clarin, Secretary.

A grand affair, with an excellent meal and a surprise in the way of unusual entertainment.

Afternoon and Evening

The late afternoon and evening have advisedly been left open to allow for your leisurely private familiarity with the City.

Dave (Aunt Ella) Clarin

WEDNESDAY, JUNE 30

8:00 a.m.

Registration—Hotel Ambassador.

1:00 p.m.

Luncheon with music.

Trellis Room, Ritz-Carlton Hotel (on the Boardwalk).

All Ladies attending this luncheon will be presented with a keepsake.

8:00 p.m.

"PLATO" Party—22 Club Room, Hotel Ambassador.

Sponsored by the International Fellowship Club, under the direction of Joan Trumbour Wiarda.

Prizes.

Mrs. Catherine Smith
Co-Chairlady

THURSDAY, JULY 1

8:00 a.m.

Registration—Hotel Ambassador.

The morning and afternoon of the final day of the Convention have not been scheduled so that you may enjoy yourself as a carefree vacationist. If you have not already done so we suggest that you visit the Steel Pier on the Boardwalk, for which you will find a ticket in your passbook which will be honored any day during the Convention, entitling you to all the facilities this interesting Pier has to offer, including Motion Pictures, Vaudeville, Water Circus, Dancing, Name Bands, Exhibits, etc.

7:00 p.m. to 2:00 a.m.

Annual A. E. S. Banquet.

Rennaissance Ballroom, Hotel Ambassador.

Dinner—Community Singing—Awards.

Entertainment—Continuous Music for Dancing.

Joan Trumbour Wiarda
Plato Party Hostess

International Fellowship Club

Robert W. Renton
Chairman

The International Fellowship Club will again play an important part in entertaining the registrants of the A. E. S. Convention in Atlantic City. Made up of suppliers, distributors, and their representatives throughout the country, the Fellowship Club each year arranges various social events to help make the annual conventions of the Society memorable occasions for all who attend. The generous financial contributions of the Fellowship Club members make these events possible, and the Club extends a cordial welcome for everyone attending the convention to take part.

Following is a list of the special activities sponsored by the Fellowship Club.

George L. Nankervis
Third Vice-Chairman

Louis M. Hague
First Vice-Chairman

Annual Luncheon
Monday, June 28

The Annual Luncheon (for members) is scheduled to begin at noon to allow adequate time, before the commencement of the afternoon Educational Session, for a leisurely meal, the election of officers, discussion and final arrangements for the Open House to be held that evening.

T. A. Trumbour
Permanent Secretary

Open House
Monday, June 28

Monday evening, in the Ballroom of the Ambassador Hotel, the Fellowship Club will hold its annual Open House. All registrants, men and women, are cordially invited to attend. Music, dancing and presentation of special awards will take place, and light refreshments will be served. This party is made possible by the generous contributions of firms selling to the plating and finishing industry. These firms and their representatives join the Fellowship Club in inviting all registrants to attend the Open House to get acquainted and to renew old friendships.

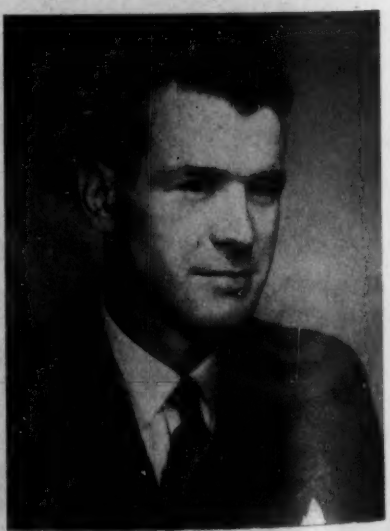
Rudy Hazucha
Second Vice-Chairman

Ladies' Card Party
Monday, June 28

The Ladies' Card Party will be held at the Ambassador Hotel from 2:00 p.m. to 4:00 p.m. The Fellowship Club will also sponsor this affair. Chairladies will be Mrs. A. P. Munning and Joan Trumbour Wiarda.

Golf Tournament

This is in the charge of *Mr. Joe Duffy*, Chairman of the Golf Committee. All interested registrants are requested to bring golf clubs and equipment. This tournament will be held Tuesday afternoon, June 29th, at the Atlantic City Country Club. An informal luncheon will be served at the club from 12—1:30. Tee-off between 1—2 p.m. Transportation to the lcub from the Convention Headquarters will be arranged. Suitable awards will be made to the winners.



Joe Duffy
Chairman, Golf Committee

The Hydrogen Ion

By J. B. Mohler and H. J. Sedusky, *Research Chemists*

ALTHOUGH every plating bath has a pH range, only a few of the baths are held in the range by actual pH control. Others are held in the range by control of free acid or free alkali; in a few cases, no effort need be made to either measure or control pH.

The measurement of pH is a measurement of the hydrogen ion concentration and as such is a direct determination of the acidity or alkalinity of a solution.

Acids and Bases

From a knowledge of the characteristics of acids and bases it might be expected that acids would be described in terms of the hydrogen ion and bases in terms of the hydroxyl ion. Actually these two ions, which are the components of water, are so related that an acid, neutral, or basic solution may be described in terms of either ion. However, the hydrogen ion is universally used to describe solutions of all types.

The characteristic properties of acids can be attributed to the hydrogen ion concentration. Obviously, this active ion can stimulate certain specialized taste buds, for acids are invariably described as having a sour taste. Although it is possible to recognize them by this crude and somewhat simple method, it is easier and safer to use an indicator such as blue litmus, which changes to red when immersed in an acid solution.

Acids of sufficient strength will react with certain metals to release hydrogen, with alkaline carbonates to release carbon dioxide and in general with bases to form salts. When the pH is greater than 7, the solution is basic. It is characterized by its ability to turn red litmus blue and to react with acids to form salts.

Ionization of Water

In pure water, which is neutral, equal and very small amounts of hydrogen and hydroxyl ions exists, thus:

$$H_2O = H^+ + OH^-$$

The ionic concentration of both the hydrogen and hydroxyl ion is 10^{-7} moles per liter. In any water solution the product of the concentration of these two ions in moles per liter is 10^{-14}.

$$\text{Conc. } H^+ \times \text{Conc. } OH^- = 10^{-14}$$

The very low concentration of ions in pure water accounts for its poor conductivity. In fact for practical purposes, pure water may be regarded as an insulator. However, if even relatively small amounts of salts are dissolved, it immediately becomes capable of conducting appreciable quantities of electricity.

The ionic concentrations for pure water are:

Ion	*Grams per Liter*
H^+	0.0000001
OH^-	0.0000017

By contrast, a liter of normal solution of sodium chloride, 70 per cent ionized, would produce:

16.1 grams or sodium ion
24.9 grams of chloride ion
17.5 grams of un-ionized salt

NaCL (58.5) produces:

$$NaCL\ (17.5) \rightleftharpoons Na^+\ (16.1) + CL^-\ (24.9)$$

Also, if one mole of hydrogen chloride gas is dissolved in water the following will result:

HCL: 36.5 Grams 78 per cent ionized
CL: $35.5 \times 0.78 = 27.7$ Grams CL^-
H: $1.0 \times 0.78 = 0.8$ Grams H^+

28.5 Grams Total

$36.5 - 28.5 = 8.0$ Grams un-ionized HCL

The concentration of hydrogen ion is conveniently expressed in terms of pH as follows:

$$pH = \text{Log} \frac{1}{H^+}$$

$$= \text{Log} \frac{1}{0.78}$$

$$= \text{Log } 1.28$$

$$= 0.11$$

Buffer Action

A liter of hydrochloric acid solution at a pH of 2 would require only 0.4 grams of sodium hydroxide to neutralize the solution and yet a typical nickel bath at the same pH would require 25 grams of sodium hydroxide for the same purpose. This is true because the boric acid present in the nickel bath is only ionized to the extent of about one hundredth of one per cent

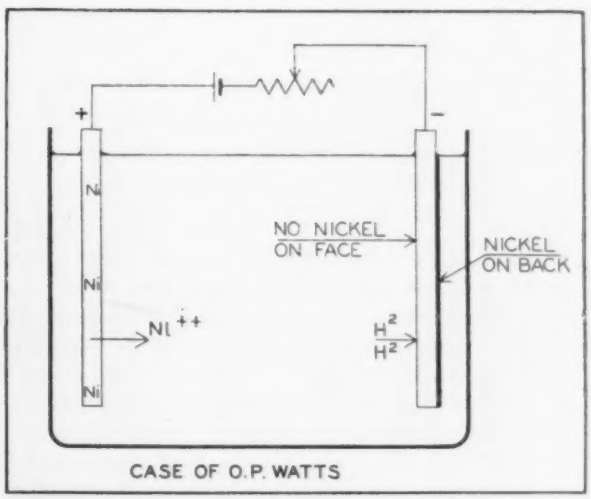


Figure 1. Plating on the back of a cathode.

and furnished a relatively small amount of hydrogen ions. As alkali is added, the hydrogen ions are neutralized but more are immediately formed from the un-ionized portion of the boric acid. Thus the un-ionized portion acts as a hydrogen ion reservoir and will require appreciable alkali for complete neutralization.

This reservoir of hydrogen ion supplied by the boric acid accounts for the buffering action of this acid. Buffering action is the tendency of the bath to remain at the same pH even though small amounts of acid or alkali are added to the bath. Buffering action is important during metal deposition because the pH of the solution in the immediate vicinity of the cathode will not change appreciably in a buffered bath.

If the hydrogen ions are depleted at such a rate as to seriously raise the pH in the vicinity of the cathode during plating, nickel may stop depositing, as in the case of O. P. Watts[1] wherein nickel would not deposit on the portion of a cathode facing the anode but did deposit on the back of the cathode. See Figure 1.

Hydrogen Ion Limits

The pH of a nickel bath is held within limits by adustment with a strong acid and the hydrogen ion reserve is controlled by addition of boric acid.

Table No. 1 shows the common methods of controlling and determining acidity or alkalinity for various plating baths.

Table No. 1

Bath	*Method of Controlling pH*	*Method of Determining Acidity or Alkalinity*
Lead Fluoborate	Addition of Fluoboric Acid	Titration with Sodium Hydroxide
Acid Tin	Addition of Sulfuric Acid	Titration with Sodium Hydroxide
Watts Nickel	Addition of Sulfuric Acid	Measurement of pH
Rochelle Copper	Addition of Sodium Hydroxide	Measurement of pH
Alkaline Tin	Addition of Sodium Hydroxide	Titration with Hydrochloric Acid
Brass	Addition of Sodium Hydroxide or Sodium Bicarbonate	Measurement of pH

Where original limits are set on a bath, the experimenter must take into account the method of pH control. In general, excess alkali or acid is determined if the pH is very high or very low (usually above 12 or below 2) for in these regions relatively large amounts of chemicals are required to effect a small change in pH. In the intermediate region a small amount of strong acid or alkali will effect a large change in pH but in general, this region is characterized by buffers which have a reserve of un-ionized ion to resist changes in pH.

Colorimetric Measurement of pH

The indicators so common to analytical chemistry are organic compounds that undergo a change in color over a definite pH range.[2] For example, the compound methyl red changes from red to yellow over the pH range of 4.2 to 6.2.

A series of buffer solutions can be prepared to cover this range from the following information:[3]

50 ml. A + x ml. B diluted to 200 ml.
A = 0.2 M. KH o-phthalate
B = 0.2 M. NaOH

pH	*ml. B*
4.2	3.70
4.4	7.50
4.6	12.15
4.8	17.70
5.0	23.85
5.2	29.95
5.4	35.45
5.6	39.85
5.8	43.00
6.0	45.45
6.2	47.00

Color standards can now be prepared from the above solutions by adding one ml. of methyl red solution to each one. If one ml. of methyl red solution is also added to an equal volume of an unknown solution in this pH range, its pH can be determined by direct visual comparison.

In cases where the unknown solution is cloudy or colored the following scheme is utilized to compensate for these variables.

A tube containing the sample to be tested is placed behind one of the standard comparison tubes. Next to this is placed another tube containing a portion of the sample plus a measured amount of indicator and in front of this is placed a tube of distilled water to give the same total liquid depth. In each case the same amount of indicator, solution, glass and interfering color or suspended material appears. Fig. 2.

The colorimetric method is subject to errors and requires some judgment in shades of color but in many cases the pH limits set on a bath are specified as colorimetric so that errors will be the same as in the original

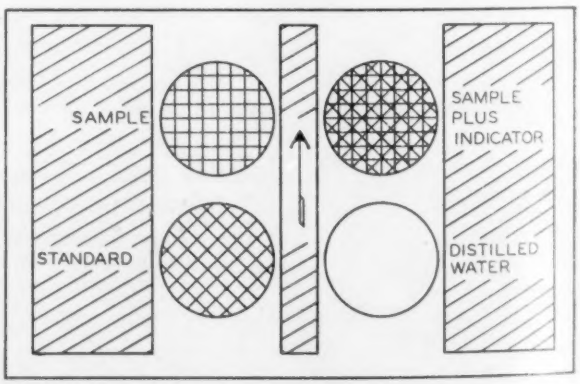
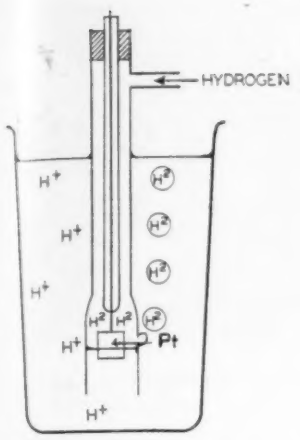


Figure 2. Scheme for the colorimetric determination of the pH of colored or turbid solutions.



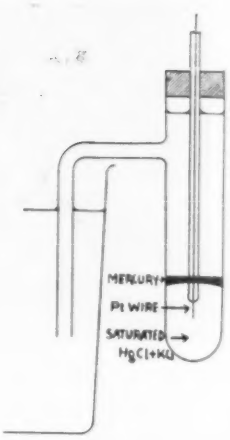


Figure 3. The hydrogen electrode. Figure 4. The calomel electrode.

work. The method is convenient and satisfactory for the control of many baths.

Electromteric pH

There are several standard cells, or more correctly half cells, that are important to the determination of pH. Those based on a metal function on the principle that a metal immersed in a solution of one of its ionizable salts will develop a voltage of potential difference. This forms a half cell and the potential is the single electrode potential. Two such half cells form a battery, as for example the Daniel cell, which consists of zinc immersed in a zinc sulfate solution separated by a porous membrane from copper immersed in a copper sulfate solution. Upon connecting the two electrodes with a conductor, curent flows from the copper to the zinc.

For reference work, reproducible half cells are used, of which the most acceptable fundamental standard is the normal hydrogen electrode. This electrode has arbitrarily been assigned a value of zero and is thus not only the reference for pH but for all electrode potentials. This is one reason why we hear continual reference to metals that lie above or below hydrogen in electrochemical tables. The electrolyte for a standard hydrogen cell consists of a solution of hydrochloric acid containing one gram ion of hydrogen per 1000 grams of water. Contact is made through a platinum strip coated with finely divided platinum black. Hydrogen gas, at one atmosphere pressure, is bubbled through the solution and over the platinum surface which acts as a metallic hydrogen electrode under the above conditions. Figure 3 illustrates the principle of the hydrogen electrode.

The saturated calomel cell, having a potential of .246 volts on the scale hydrogen equals zero, is commonly used in commercial laboratories. This half cell consists of mercury in contact with a solution saturated with both mercurous chloride and potassium chloride. External contact is made with a platinum wire. See Figure 4.

A complete cell may be formed with this half cell in combination with the hydrogen electrode and may be used to measure pH. In this case the hydrochloric acid in the hydrogen electrode is replaced by the solution to be measured.

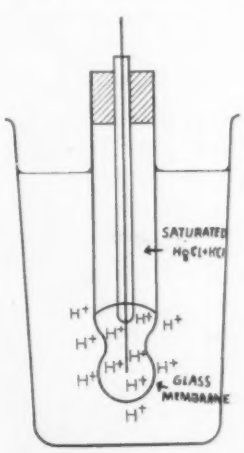
In practice the calomel cell is usually used in combination with the glass electrode which is based on the finding that a glass membrane separating two solutions gives potentials that depend on the hydrogen ion concentrations. Figure 5 illustrates a glass electrode.

Modern pH meters utilize these two half cells. The instrument contains a temperature compensator and reads directly in pH. The weak currents that flow during the balancing of the instrument are magnified by electronic means. Electronic pH meters are of two types. One employs a direct reading meter similar to a common volt meter and is usually a rugged and rapid reading, instrument designed for industrial work, where an accuracy of 0.1 pH unit is sufficient. A more precise, but still convenient, instrument uses the balanced circuit principle and is accurate to 0.02 pH unit. This second instrument is particularly convenient for reference work and for occasional laboratory measurements. A schematic representation of a pH meter is shown in Figure 6.

Titration

In the case of the stannate tin bath, where the available sodium hydroxide must be held within prescribed limits, it is not feasible to operate the bath by pH control. During plating, the hydroxyl ions in the immediate vicinity of the anode are combined with the tin going into solution to form sodium stannate. In this case the available hydroxyl ion content is of primary importance and the most satisfactory determination is by chemical means. This is accomplished by adding acid to a sample until all the hydroxide above a certain pH is combined. The amount of acid added is then a direct measure of the amount of hydroxide available. In order for this method to be precise and thus successful, it is necessary to know when the available hydroxide is just used up.

The initial pH of a bath of this type will probably be of the order 13.5. As acid is added, the pH undergoes a gradual change to approximately 12.5 after which it changes rather suddenly to about 10.5. Since a relatively small addition of acid will cause a large change in pH in the range 12.5 to 10.5, a pH value in



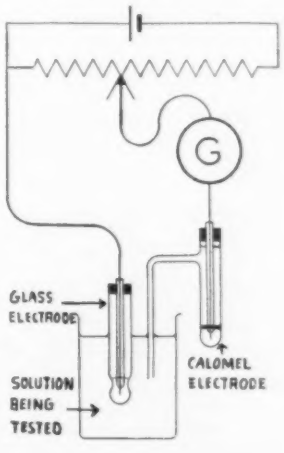


Figure 5. The glass electrode. Figure 6. The pH meter.

this range will be suitable for an end-point. Actually this portion of the pH curve is not dependable over the whole range since it is in the range where carbonate will act as a buffer. It has been found by experiment that a pH of 11.2 is a good one to choose for an end-point, since this pH will give very close to the same result with almost any amount of carbonate encountered in the ordinary analytical procedure.

A glass electrode is very convenient and accurate for this case if acid is added until a pH reading of 11.2 is obtained. However, each glass electrode may have its own individual characteristic point at which the pH changes rapidly for this type of bath, so that for a new electrode a titration curve should be determined with a known solution. The optimum pH may be found to be anywhere from 11.0 to 11.3 and the inflection point from this standard curve determines the pH end-point to be used for all subsequent titrations. If a glass electrode is not available, an indicator such as sulfo-orange that changes in this range, may be used. Indicators are the most convenient means of determining the end-point of a quantitative reaction. They are preferred for a titration where they adequately indicate the end-point.

In some cases the precipitation of a metal as the hydroxide can be used as an end-point, as in the determination of free fluoboric acid in the lead fluoborate bath. In this method the sample is diluted to a definite volume and standard sodium hydroxide solution is added until a slight permanent turbidity just appears. By this simple procedure, control of the acid in the bath is possible; but as simple as the method appears it was only determined as a result of extensive experimentation.

Selection of Method of Measuring pH

The method selected for any given pH application depends upon the pur ıose of the measurement and the means at hand. The simplest case of pH measurement is that in which it is desirous to know whether a solution is acid or alkaline. By the use of litmus and observation of the resulting blue or red color it is immediately known whether the solution is above or below pH 7. The accuracy of this type of measurement can be increased by using one of the modern papers that give a different color or shade of color for each two pH units. For more accurate, but still rapid work,

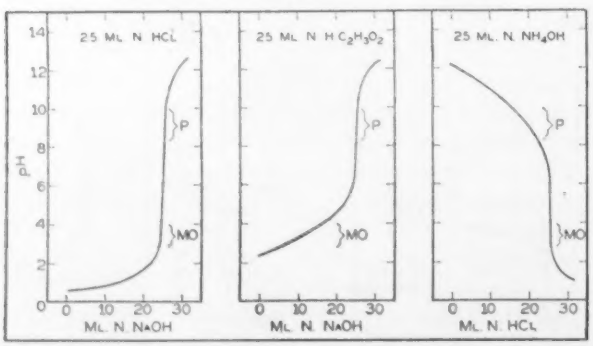


Figure 7. Titration of various reagents with normal solutions.

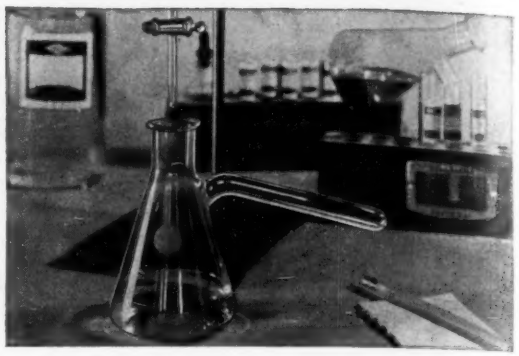


Figure 8. Titration flask for use with the block comparator.

dyes are available that will measure pH to a half unit. Color tubes are usually accurate to 0.2 pH unit and the pH meters are accurate up to 0.2 pH unit. With specially designed research equipment, it is possible to determine pH to 0.001 unit but this is beyond any consideration for electrodeposition.

The Watts type nickel bath offers a good example of pH control. For instance; assume that pH limits of 5.2 to 5.8 are specified. The choice of method of control would be influenced by whether the laboratory or plant were to conduct the measurements, the equipment available, and the number of solutions to be determined. The laboratory man would prefer a rapid reading pH meter if the number of solutions to be checked was numerous. But in the case of a plant man being required to run one determination a day, the preference would probably tend toward the color tubes or special pH papers.

It is interesting that a solution as highly colored as the nickel bath can be controlled by a colorimetric method that is dependable and in many cases specified.

This does not mean that the colorimetric method is preferred but merely that the range specified is for colorimetric pH. The pH of a solution as measured by the glass electrode will usually be found to be lower than the colorimetric values. In case colorimetric pH is specified, the pH effect should be investigated when the bath is set up for the first time. A convenient method of doing this is to prepare a bath on the high pH limit and measure the pH both colorimetrically and electrometrically then adjust the pH with acid to the mean and the low limits and repeat the measurements. This gives the difference in the two methods and establishes the limits in terms of electrometric pH. The more thorough method of determining the pH limits is to prepare a series of baths containing the maximum, the mean, and the minimum amount of chemicals, and to adjust each to the high and low pH limits. This is the more satisfactory method, since at the same time data may also be taken on the plating characteristics over the whole range. It is also convenient to take specific gravity measurements and possibly cathode efficiencies if these will be of value in the operating data. This procedure is of value because it is a means of having an initial record of laboratory performance of the bath. It also indicates whether the pH range can be some-

what broader than that specified or whether it is desirable to operate near the upper or lower limits.

Titration Cases

The method of titration for acid in acid plating baths depends upon the strength of the acid and the presence of ions that may interfere. Ions may be present that will cause buffer action or form insoluble hydroxides to obscure the end-point.

If a strong acid is to be titrated, such as sulfuric acid in the acid copper bath, normal sodium hydroxide is added to a diluted sample until a color change is observed, using methyl orange indicator. Sulfuric acid, being a strong acid, maintains a relatively low pH until the acid is almost all used up, then the pH rises on addition of only a few drops of normal reagent. Under these conditions it is quite easy to determine the amount of acid present.

Figure 7 demonstrates that when a weak acid is titrated, phenolphthalein should be used as an indicator and when a weak base is titrated, methyl orange should be used.

Consider a solution of fluoboric acid and lead fluoborate. If we add strong alkali to a solution of this type, the fairly strong fluoboric acid will be used up and the pH will rise, but at a pH, depending upon the dilution of the sample, lead will start to precipitate as the hydroxide. Since this recipitation takes place after the free acid is approximately used up, it may be used as an end-point. Actually the point at which this takes place varies with the dilution of the sample so that all determinations are necessarily made at the same dilution; usually 10 cc. diluted to 250 cc. In this case the exact amount of fluoboric acid is not known, but the same procedure will give the same result so that empirical chemical limits can be set up.

Titration of spent pickle solutions is another example of the same sort. If a used hydrochloric acid pickle solution is diluted and titrated with sodium hydroxide, using methyl orange as an indicator, it will be found that ferrous hydroxide will just begin to precipitate at the point where the indicator begins to change. Actually the green color of the ferrous hydroxide can be used as an indicator, but the first change of the methyl orange from pink to orange is also reliable. The control limits on pickle solutions are usually wide enough to permit using normal sodium hydroxide and going a few drops past the end-point to

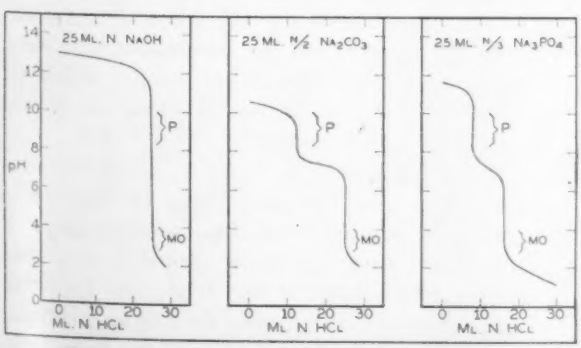


Figure 9. Titration of various alkalies with HCl.

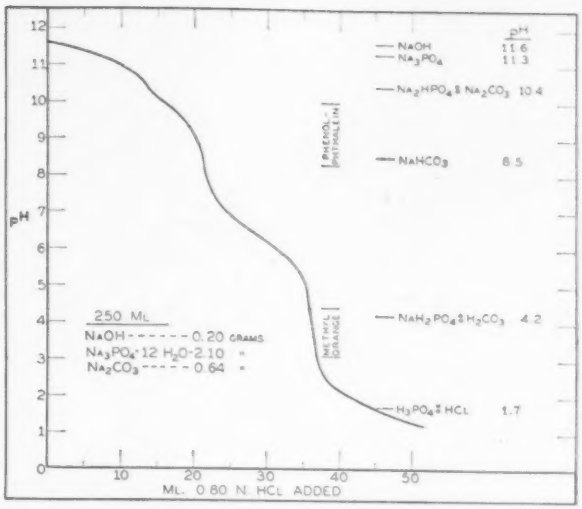


Figure 10. Titration of various alkalies simultaneously with HCl.

a definite green precipitate. This type of titration is sufficiently accurate for plant control and permits the non-technical operator to be more sure of the end-point.

In some cases it is advisable to use more or less unorthodox procedures in order that a solution may be controlled by the operator. In the case of a stannate tin bath, the titration for caustic, using sulfo orange indicator involves a difficult end-point for work outside the laboratory and further the bath cannot be satisfactorily controlled by pH in the high pH range.

These difficulties can be overcome by using violet indicator and redefining the caustic limits on the bath as follows:

If the bath is titrated to a pH of 12.6 to 12.8 using the violet indicator as a standard, then 5 grams per liter of sodium hydroxide will be present at the end-point and this can be taken care of by subtracting this amount from the limits. The violet indicator changes from blue-green to blue purple, and the blue at pH 12.6 to 12.8 is easy to recognize if standards are used. The end-point may be easily recognized by use of the special titration flask shown in Figure 8. The side arm of the flask fits directly into a color comparator block.

As an excellent illustration of the way in which titrations may be used, it is of interest to consider the titration of a solution containing carbonate, caustic and phosphate. These chemicals are quite common and, in fact, all three are quite often used in alkali cleaners.

Figure 9 illustrates the typical titration curves obtained with each of these compounds.

Upon adding hydrochloric acid to a solution of all three of these compounds, the following reactions take place:

1. $NaOH + HCL = NaCL + H_2O$
2. $Na_3PO_4 + HCL = NaCL + Na_2HPO_4$
3. $Na_2HPO_4 + HCL = NaCL + NaH_2PO_4$
4. $Na_2CO_3 + HCL = NaCL + NaHCO_3$
5. $NaHCO_3 + HCL = NaCL + H_2O + CO_2$
6. $NaH_2PO_4 + HCL = NaCL + H_3PO_4$

If we add acid until the purple color of phenolph-

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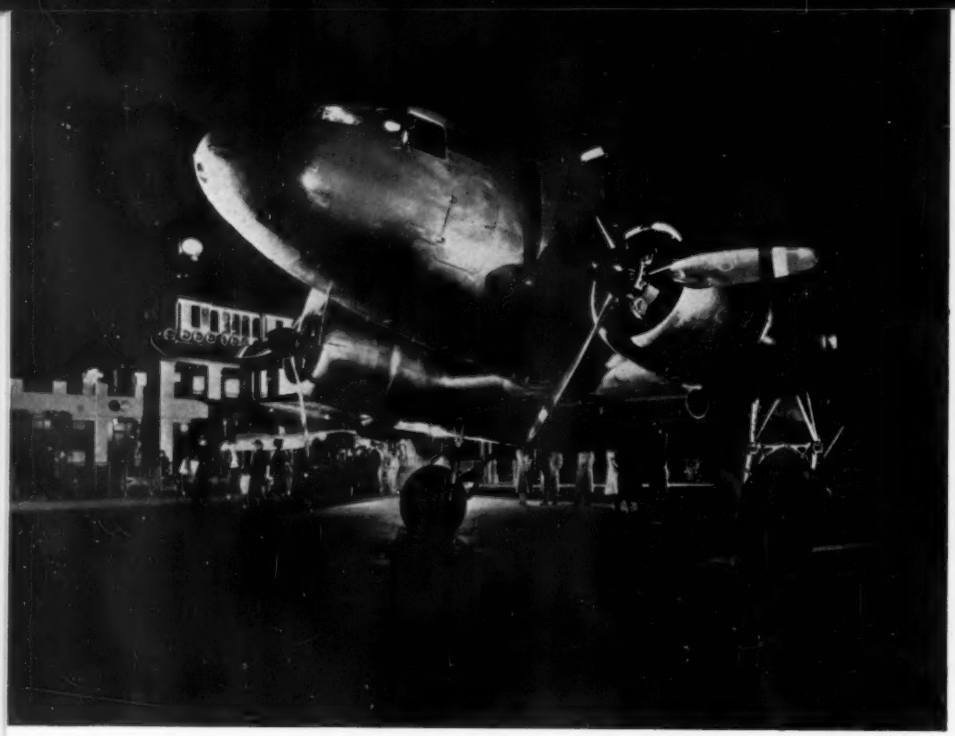

Plating and Airlines Efficiency

By Joseph Albin, *New York, N. Y.*

A good example of how special plating requirements are performed in an efficient manner on aircraft engine parts is described in this article. Planned engineering specifications provide the key to success in this precision plating set-up.—ED.

THE plating shop of American Airlines at its main overhaul base at Tulsa, Oklahoma, which began operations last year, was planned to carry out an unusual multiplicity of plating jobs. Much engineering thought went into the selection of equipment and layout, and the method of production control by means of process specifications.

The main function of the Tulsa shop is to replate aircraft engine parts for engines being rebuilt in the scheduled overhaul period. The parts received in the plating shop for reprocessing have had over 700 hours of engine time. The partially worn coating is completely stripped off and new plating applied. Insofar as possible, the operations of plating of the original manufacturer are repeated. In this respect, airlines maintenance plating may be seen as a quasi-manufacturing operation. As an example, the replating of the master rod bearing of the Pratt & Whitney engine is done at Tulsa under a special licensing arrangement, whereby the engine company's specifications for reprocessing are followed.

During plating, engine parts are not mixed like new stock. The majority of parts are tagged or otherwise identified so that they can be re-inserted into the original engine. This requirement of identification would seem to impose a heavy burden on shop personnel in view of the many types of plating specified for the various parts. It is only with the help of explicitly printed directions that the flow of operations is not hampered. In the plating of any specific engine part, the operator is apprised of each step in the process, so that plating chores are completed with ease and promptness, and with practically no dependence upon the platers judgment or decisions.

Most of the plating jobs done here would be ordinarily regarded as "custom" plating. However this shop has achieved economy and a flow of operations that is characteristic of the mass-production shop. Contributing in this direction are the jigs which are specially designed and thoroughly tested out by the laboratory before being used.

Besides the functions required by scheduled overhaul, the shop does electrodepositing for build-up of worn parts as required by the base machine shop. It also does the plating operations needed in the manufacture of certain items of new stock, and for developmental projects. The plating shop is an additional unit in the manufacturing division of the Tulsa base,

which has a machine shop, sheet metal section, welding section, and cleaning section.

A great variety of plating and finishing work is carried on in what might appear as a rather confined area, the floor area measuring approximately 25 by 100 ft. However, working space and equipment have been efficiently laid out and operations proceed with a minimum of unnecessary effort.

Pre-cleaning of parts is done in the general cleaning room which is adjacent the plating room. When engine parts are disassembled in the engine overhaul shop, the component parts are passed through a solvent cleaning solution to remove oil and grease. Certain of the parts will have been received after a soft-grit blasting or sandblasting. (See article in March issue of *Metal Finishing*.) Though the parts are regarded as "cleaned," nevertheless there will usually be some contact with oil and grime. Hence, the first step in the plating shop is to pass the parts through the vapor degreaser. Subsequently the parts are usually put through the electro-cleaner.

Scope of Operations

For stripping old coats, the following baths are provided: silver strip; copper strip; tin strip; lead strip; chrome strip. These baths are arranged to be near the entrance of the plating shop, excepting the chrome strip which is associated with the chrome bath.

Equipment has been installed to perform the following plating cycles:

LEAD-INDIUM—This plating is for bearing surfaces subject to high stresses and the corrosive effects of lubricants at the higher operating temperatures. After plating a thin coat of lead followed by one of indium, the part is given a heat treatment in an oven at 350°F for 2 hours for the purpose of diffusing the indium into the undercoat. Since lead-indium plating is ordinarily applied over a silver plate, the silver plate and silver strike baths are arranged in a group with the lead bath and the indium bath. Cold and hot rinse tanks, spray rinse, oil impregnation tank, and the diffusing oven supplement the lead-indium set-up.

DOW PROCESS—On the opposite side of the room is a set of tanks containing solutions for the Dow Process of treating magnesium castings. This treatment provides an impervious oxide coating that gives better paint adhesion and protection. Tanks and solutions that comprise the Dow Process are: hydroflouric acid, arsenious oxide, cold rinse, sodium dichromate, and hot rinse.

CHROMIUM—This plating is used for maximum strength in building up dimensions and for a hard bearing surface as required in certain journals. To complete this plating there is a chrome strip, cold rinse and chrome plate bath.

CADMIUM PLATING—For selected areas of parts requiring general corrosion protection. Also applied to struts and landing gear. A cadmium barrel is utilized as well as a cadmium still tank.

SILVER PLATING without lead—indium topcoats is for "soft," smoothly working bearings. Silver plating is also used on the crankshaft bolt to afford a coating that will yield a sufficient amount on assembly.

TIN PLATING is given to certain parts for general corrosion resistance, and for areas where wear from seizing might occur. A typical part which receives tin plating is the propeller shaft.

COPPER is for build up on worn areas and for press-fit applications as in the case of wristpins; also for certain bearings.

LEAD PLATING alone is used on certain bearing surfaces, as the impeller shaft thrust plate.

COPPER-LEAD—The lead plating follows the copper on the counterweight bushing for a press-fit application.

Accessory solutions, such as the bright dips and acid dips occupy places in the center line.

Receiving frequent usage for small batches of nuts,

Figure 1
General layout of plating department.

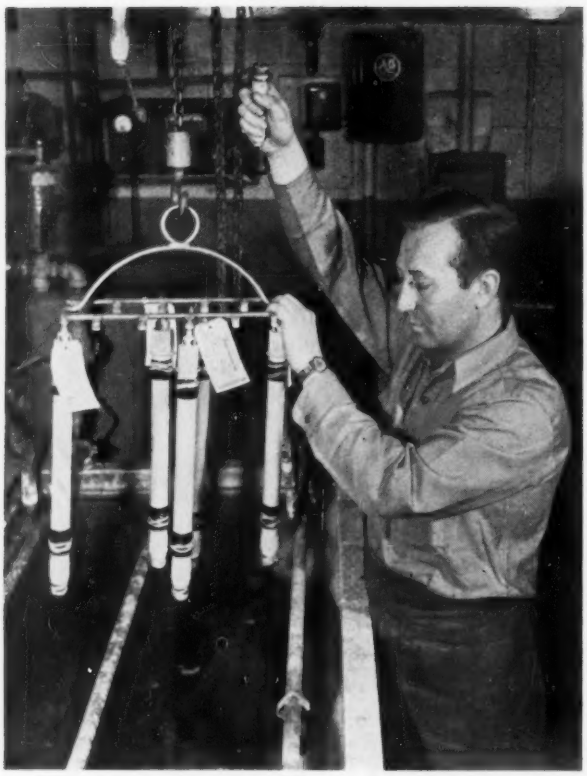

Figure II—Tin plating driveshafts. Note masking on journals.

bolts, etc., is the Handiplater, set between the cadmium barrel and the copper plating bath.

An overall view of the plating shop, showing the layout of the baths, auxiliary equipment, exhaust, lighting, hoists, etc., is shown in the illustration, Fig. I.

Construction

The provisioning of clean fresh air is done by means of three separate blower installations. The system is adjusted so that fresh air is pulled in at the entrance and routed through several areas in succession. Tank ventilation is provided by individual draft boxes, the tanks next to the walls having slots in the rear. Air velocity has been carefully calculated for each type of bath; the greater velocities being for stripping and hot acid pickling baths, a lesser velocity for boiling water solution baths, caustic and electrolytic cleaners, and finally a lower ventilating rate for the plating solutions. This planned ventilation has resulted in the avoidance of smelly, contaminated areas. Exhaust ducts are coated with a high gloss black acid-proof paint. This control of air quality is in addition to the necessary control of temperature and humidity. During hot weather, the system provides for the circulation of large volumes of air.

Drainage and waste disposal are factors being given special study in the plating industry. As is evident in the aforementioned illustration, the floor space between the baths is covered by duckboard flooring, raised four inches from the concrete flooring.

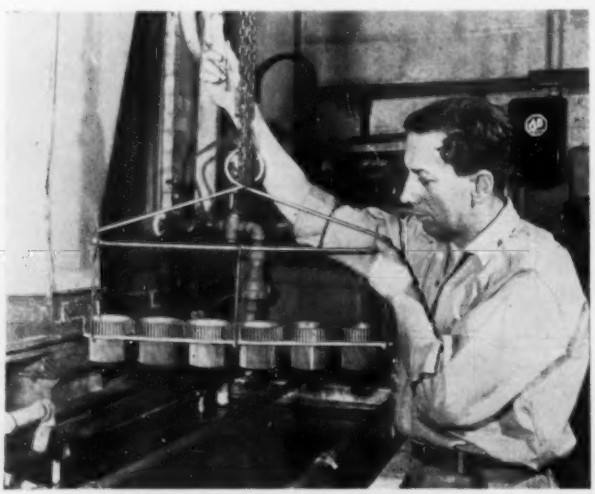

Figure III—Jig for multiple plating gears.

Figure IV—50 position rack for copper plating wrist pins.

Located under the center and side lines are three ditches which carry off drainage towards one end of the shop. The concrete floor is so sloped that fluids spilt through the duckboards may flow into the ditches. These empty into a limestone pit, so that any effluent for dumping into the sewers has its acid reacting wastes neutralized. In the disposal of chemicals, small amounts are washed down and pass through the ditches. Large amounts of waste plating matter are carried away in drums, and special disposal means are taken to avoid overburdening sewers.

Since there is observation of plating in progress and inspection of color of plate, uniform illumination of the general room area fits in very well. The fluorescent

tube lighting and arrangement of reflectors produces effects desirable for accentuating depth, form and color of solid objects. There are no high and low illuminating areas, the walls are light colored, and the worker's vision does not pass through a high contrast area. This vision principle has been a subject of study in connection with fatigue and headache, and certain industrial accidents.

Rinses are of three types: cold and hot running water baths, and the spray rinses. Blow-off comes into use particularly on parts after hot rinse, for drying purposes. Flexible hose connections with the compressed air line at several points throughout the shop permit quick drying of parts near site of bath or at work benches.

The distribution of work benches and racking benches through the shop helps in the handling of the large variety of plating jobs. A ¼-ton powered over-

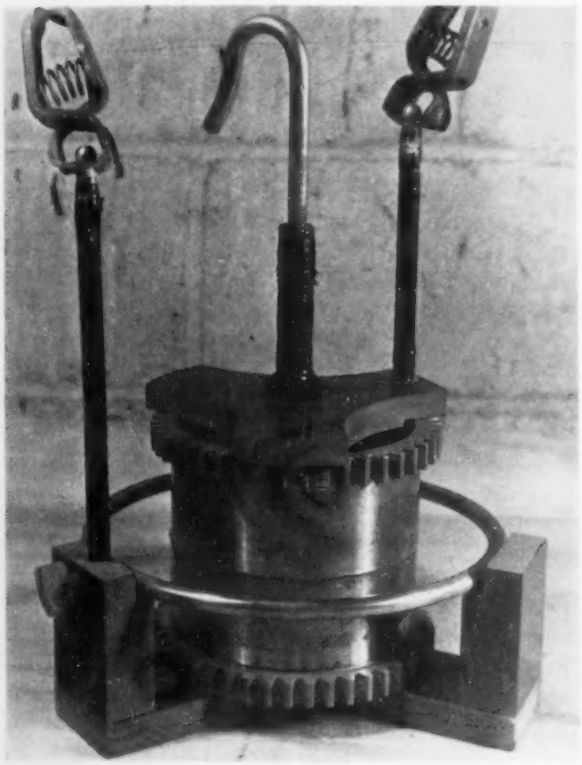

Figure V—Special arrangement for plating two gears with lead-indium.

head hoist services one side line and the center line, the rails extending the full length of the shop.

Plating current is derived from five copper-oxide rectifiers. Besides one large rectifier for servicing chrome plating exclusively, there are three other large rectifiers and a small rectifier to take care of the remaining installations. More consistent plating current control has been achieved by operating a bath where possible from a single rectifier.

Production Control

As mentioned previously, production control is chiefly by means of process specifications. Each part handled has a separate specification explaining the

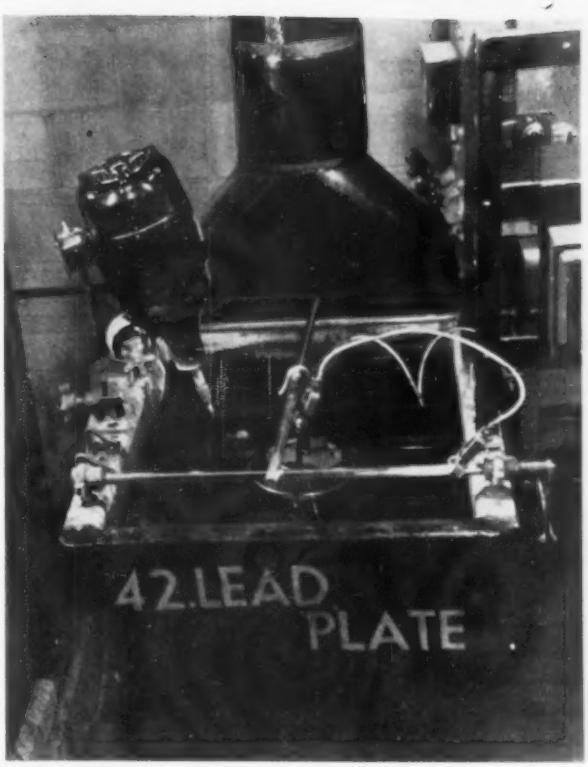

Figure VI—Lead plating gears shown in Figure V.

purpose of the finish, the service requirements, and detailing each and every step in the plating process. Times, temperatures, masking steps, voltages, currents, etc., are all rigidly adhered to in order that the completed parts pass a rigid inspection before reassembly. The operator has at all times exact procedures to follow, and is thus never at a loss as to what to do next.

Each part sent to the plating shop is identified by a part number, and by referring to the shop catalog, the operator selects the process specification that applies to the part. Here he is given information of the jig to be used, and all pertinent preparatory and plating data for that part. The specifications are supplemented by laboratory data charts and deposition rates of the

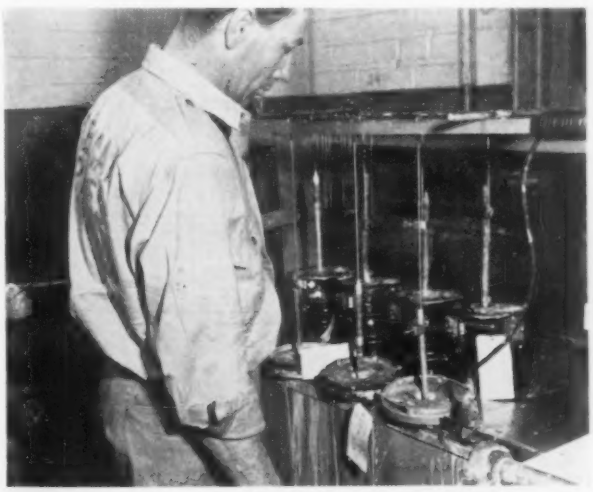

Figure VII—Plating internal bores of housings for press fits.

baths. Specifications and charts are kept in loose-leaf type binders. Procedures for the shop are in a state of constant revision and those changes which have been proven to bring about desirable results are incorporated in the instructional sheets. Specifications are prepared by the supervisor of the general laboratory in the American Airlines La Guardia Field base.

Experience in production control by the use of these process specifications was gained in the smaller plating shop operating at La Guardia Field.

Laboratory Control

In the practice of quality control as applied to the output from machining operations (or other form of direct fabrication), observation of specific characteristics in samples collected according to established time intervals will lead to the detection of machining faults. Quality control procedures permit spotting of sources in the production line that are most likely causing rejects. This leads to the timely stopping of a particular machine or other element in the production line, on which appropriate adjustments may be made.

The foregoing concept of quality control does not quite apply to electrodeposition in its present state. Uniformity in plating is assured by (1) inspection of samples, (2) regular chemical analysis of the baths, and (3) controlled operation of the bath.

The most frequently tested bath is that of the indium solution. The rate of deposition is determined each day of use, while a chemical analysis is made each week. Other plating baths are regulated largely by chemical analysis made weekly. Accessory solutions, such as the alkaline cleaner, bright dips, and acid dips are checked at less frequent intervals. Aside from the foregoing general control, each bath is covered by written procedures taking into account specific performance.

The quality of the plate is inspected for adhesion, appearance and color on both parts and on laboratory test coupons. It has been proven that quality results can be achieved if control of the bath is maintained by regular analysis and the plating specifications rigorously followed. Several direct methods for testing plate thickness and quality are now under consideration by the Airlines' chemical engineers. Chemical methods of

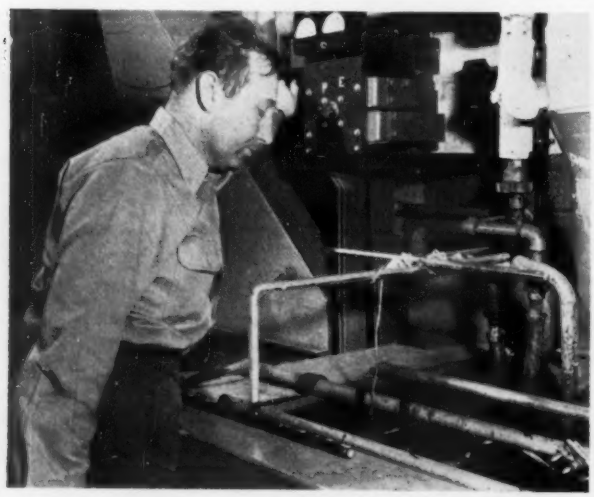

Figure VIII—Experimental hard chrome setup.

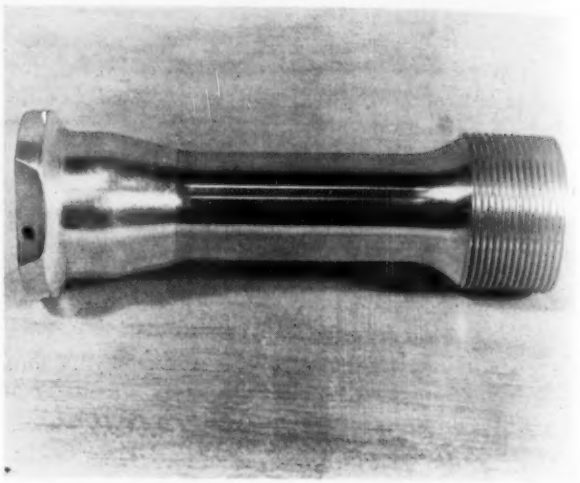

Figure IX—Crankshaft bolt plated with tin on one end and silver on the other end.

determining thickness include the weight-loss test and the rate-of-chemical-reaction test. The Magne-Gage is also used for non-magnetic coatings on a magnetic base. In cases where the instrument is not applicable, or on parts of odd shapes thickness is checked by a micrometer gage.

In carrying out analysis, duplicate determinations are made using either known or reference materials so that there is never any doubt about results. Standard analytical methods are usually followed, and in several instances Airline chemists have improvised new methods.

Jig Design

In addition to above mentioned functions, the laboratory develops and tests jigs with the goal of greater accuracy in coating the part and for increased output per bath. The reader is referred to the illustrations of various jigs. Fig. II shows a number of drive shafts being immersed in the tin plating bath. Each shaft is attached to the jig by a threaded section, the jig itself being made of welded members. The journals which do not receive tin plating are masked with tape.

In Fig. III six gears are being tin plated on a jig which bypasses old techniques of hanging on hooks. Each of these heavy gears is firmly retained on the jig and not liable to fall off, as in the case of hooks. Although identification tags are not affixed to these particular parts, the ordering of gears from right to left serve as an identification system for the operator.

A jig which was the result of considerable revisions is that shown in Fig. IV for the copper plating of wrist pins. An effort has been made here to arrive at mass-production results, as a large quantity of these wrist pins are plated.

The design of the special jig, Fig. V, for lead-indium plating of the rear gear was developed after much trial. A certain profile effect is achieved by the circular anode and its position with reference to the gears, two of which are plated at a time. The jig is made of Micarta. Gear teeth are masked. The anode

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Electrolytic Pickling

By Dr. Konrad Weller, *Stuttgart, Germany*

Translated from the German by Dr. J. C. Bacon

EDITOR'S NOTE—The present article reviews and evaluates the various methods developed for electrolytic pickling (not to be confused with electropolishing) for scale removal and surface cleaning. These processes, widely used in European countries, are finding ever increasing application in this country at the present time.

Introduction

THE idea that cleaning and pickling of metals could be accomplished with the aid of an electrolytic current is old, extending into the latter part of the previous century. In 1862 *J. S .Williams* (1) suggested the rather fantastic plan of cleaning the outside of ships by connecting the ship's hull to the positive pole of a current source, and suspending in the water about the ship large iron plates connected to the negative pole. A few years later *A. Gutensohn* and *J. N. James* (2) proposed pickling metal anodes in an acid medium. The first proposal of cathodic pickling in acid solution was set forth by *S. C. Cowper-Coles* (3). The oldest suggestion of pickling by using alternating current came from *W. St. Rawson* (4) *W. Machu* (5) gives an excellent and thorough summary of the patents in the field of pickling and cleaning up to about 1938.

Despite the numerous patents and voluminous work, only a few electrolytic pickling methods were reduced to practice. However, in recent times there has been an increasing turn of interest to the practice of electrolytic pickling.

Chemical and Electrolytic Pickling

Pickling has as its object the removal of oxidation impurities such as rust and scale from the surface of metal objects. This is generally accomplished by the use of pickling acids (sulphuric, hydrochloric, or phosphoric) which remove the oxides in a simple chemical manner,

(1) $H_2SO_4 + FeO \rightarrow FeSO_4 + H_2O$

or by attacking the metal under the oxide and thereby mechanically freeing the oxide from the metal.

(2) $H_2SO_4 + Fe \rightarrow FeSO_4 + H_2$

The action of the method according to equation (2) is to develop hydrogen rapidly beneath the surface of the scale, thus forcing it loose. The concurrent use of an electrical current is to increase the efficiency of the above mentioned chemical actions.

A distinction is made between anodic and cathodic processes, as well as alternating polarity and conducting medium processes. While anodic pickling accelerates the attack on the metal surface and thereby rapidly reduces the mechanical binding of the oxide to the metal, cathodic pickling increases many fold the loosening effect by the hydrogen liberated.

A third procedure, using alternating polarity of the current, aims at successively combining both actions and therefore accentuating them. This type of pickling may also be done with alternating current.

The pickling processes based upon the use of a conducting medium without direct connection of the work to the current constitutes a fourth group, since in this case both anodic and cathodic effects are obtained simultaneously, but in a different manner.

A study of the known processes for electrolytic degreasing, cleaning, pickling, and polishing shows the transition between these surface treatments to be gradual, and rigorous limitations between one and another cannot be drawn. This electrolytic degreasing and cleaning, as well as cathodic pickling, depend essentially upon the liberation of hydrogen upon the metal piece which results in the loosening and removal of surface impurities. Anodic pickling, however, which depends upon the combined action of metal solution and oxygen liberation can be modified for a shining or polishing action by using a high current density. Electrolytic pickling occupies a position intermediate between electrolytic cleaning or degreasing and electrolytic polishing.

Advantages and Disadvantages of Chemical and Electrolytic Pickling

Before the discussion of the various methods of pickling is ended, it is desirable to give a short review of the advantages and disadvantages in chemical and electrolytic pickling. Not only do these contrasting positions show future prospects but also the limitations of electrolytic processes.

A. Chemical pickling:

Advantages

1. Low plant installation costs.
2. Simple manipulation.

Disadvantages

1. The pickling time is long and therefore requires an extensive plant which in part counteracts its simplicity.
2. Strong acids are necessary starting materials for the bath and there is a definite minimum concentration of acid necessary for pickling.
3. Increasing iron content in the acid reduces its action so that in a given time it becomes less economical to use.
4. The disposal of the pickling residue is expensive and at present causes technical difficulties.
5. The acid demand is relatively large.
6. Chemical pickling of stainless steel is difficult.
7. The use of pickling additives (inhibitors) introduces metal loss.
8. The dissolved iron and spent acid are mostly lost.

B. Electrolytic Pickling

Advantages

1. Essentially short pickling time.
2. The use of strong acid is not necessary and the acid used is nearly completely consumed.
3. Electrolytic pickling baths are quite insensitive to high concentrations of iron salts since the sulfate of the salt has a pickling action at the anode. Therefore the concentration of $FeSO_4$ may be allowed to approach the saturation point. (4)
4. The disposal of the pickling residue causes less difficulty (weaker acids and longer life of bath).
5. Acid consumption is low.
6. Electrolytic pickling of stainless steel is simple.
7. By cathodic pickling nearly no metal loss is introduced; i.e. the mass of gears remains constant.
8. There is a possibility of cathodic deposition of the dissolved iron and the recovery of free acid.
9. Good efficiency is maintained by the use of electrolytic pickling processes.

Disadvantages

1. Relatively higher equipment cost because of the necessity of supplying a current source.
2. High current cost which is partly counteracted by the lower acid consumption.
3. In many electrolytic processes a black sludge layer is formed on the work which can only be removed by vigorous wiping.

The preceding review appears to speak for the relative advantages of the electrolytic pickling process.

Anodic Pickling

Fundamentals

In anodic pickling the following basic processes occur. Process A—in a sulfuric acid, or sulfate containing bath, the sulfate ions migrate to the anode and penetrate through the pores of the rust or scale to attack the surface of the underlying metal according to the equation

$$(3) \qquad SO_4 + Fe \rightarrow FeSO_4$$

This reaction proceeds undisturbed only when a sufficient quantity of H_2SO_4 is present in the bath, otherwise the iron surface becomes passive and the anodic process of iron solution is replaced by the evolution of oxygen:

$$(4) \qquad 2SO_4 + 2H_2O \rightarrow 2H_2SO_4 + O_2$$

Instead of forming iron sulfate, oxygen and sulfuric acid are formed on the anode.

Chloride solutions are more efficient than sulfate solutions for anodic pickling probably because the smaller chloride ion can penetrate the pores of the oxide or scale layers more easily. Chloride solutions also have the advantage that under the technical methods in use, passivity of the metal surface can hardly be caused. Through this anodic attack upon the metal surface of the work, the metal layer to which the oxide is adhering is removed and therefore the scale falls off.

Besides the solution of the iron there is a second possible process (Process B) in anodic pickling. The electrical conducting scale layer composed of Fe_2O_3 acts as an insoluble anode upon which sulfate ion is deposited according to equation (4); that is, sulfuric acid and oxygen are formed on the surface of the work. The former accelerates the chemical solution of the oxide while the oxygen loosens the layer in a similar manner to that of the cathodic hydrogen. The same process takes place on bright iron surfaces when a definite current density, called the threshhold current density, is exceeded. In this case too, the anodic solution of the iron is replaced by the liberation of oxygen.

An advantage of anodic pickling processes lies in the fact that saturation of the base metal with hydrogen, which causes the much feared embrittlement, is not possible. As a disadvantage, a severe roughening of the metal surface occurs under certain conditions.

Sulfuric Acid Pickling

Of special practical interest are those processes which are operated in sulfuric acid of moderate concentration with such a high current density that a vigorous oxygen evolution occurs (see process B). This process, under specific conditions, will produce a polished surface, or in other words the electrolytic pickling is gradually converted to a polishing action.

German Patent 572,453 refers to the anodic cleaning of iron or steel wire and tape before galvanizing. It recommends an anodic treatment in a cold sulfuric acid solution containing 35-250 gm. H_2SO_4/l. with a current density of 185 A/f^2. This process makes possible the complete cleaning of annealed iron wire with a heavy oxide film. The speed with which a linear unit of 1 cm. passes through the bath should be under 16 sec. Up to a current density of 185 A/ft^2 only an anodic solution of the iron is observed. At higher

current densities, however, the dissolving of the iron is displaced by a lively oxygen evolution which loosens the adhering film of scale. Embrittlement cannot occur in this process. The minimum current density necessary to obtain the described effect depends upon the temperature of the bath, the thickness of the wire and the thickness of the oxide film.

U. S. Patent 1,865,470 recommends 25-75% sulfuric acid (preferably 40-50%) for bright polishing previously descaled steel. The work is held in the bath for 1-1½ minutes at a current density of from 84-260 A/ft² at a temperature of 50-100° F. (preferably 60-70° F.). Before this treatment it is descaled cathodically in a 2-20% H_2SO_4 solution with current density of 10-160 A/ft², at a temperature of 160° F. for 1-6 minutes. The work can be transferred to the polishing bath with or without intermediate washing. When the current density in the polishing bath is too low or the temperature is too high the surface comes out well cleaned but not polished, and has the appearance of a piece pickled normally. The beginning of electrolytic polishing is connected with the appearance of patents on the anodic preparation of persulfuric acid, which is favored by a high current density and low temperature. The initial current density decreases rapidly when anodic polarization takes place. After this drop in current density the pieces are cleaned but not polished. In a short time the current density becomes constant at an appreciably lower value. As the bath temperature increases the current density required must also be increased. Addition of oxidizing agents such as chromic acid, sodium perborate, hydrogen peroxide, or nitrates acts satisfactorily and the undesired embrittlement of the surface is fully avoided by this process.

German Patent 451,620 recommends for pretreatment of wrought iron, cast iron, steel or copper alloys, an anodic treatment in 45-55% sulfuric acid with a minimum of 90 A/ft². Through this treatment the crystals of the base metal are left bare and charged with oxygen. In order to increase the pickling action one can add nitric acid, but for the addition of 2% HNO_3 the current density must be raised about 50 A/ft².

Anodic pickling processes have also been devised which require stronger, more concentrated sulfuric acid. Swiss Patent 115,942 recommends working in an 87.5% sulfuric acid bath with 6-8V for about 3 minutes. The initial current density of 20-45 A/ft² falls to 1-5 A/ft² during the pickling. U. S. Patent 1,793,914 recommends pickling wire in concentrated sulfuric acid at 125° F., with 12 V at a current density of 30-45 A/ft² using either direct or alternating current.

For anodic pickling in dilute sulfuric acid we refer to U. S. Patent 1,574,823 and British Patent 480,352. *J. D. Geiser* (6) suggests anodic pickling of stainless steel tape in 5% sulfuric acid.

Hydrofluoric Acid Pickling

The first time that hydrofluoric acid was suggested for anodic pickling was probably in British Patent 21,950 in 1891. Twenty-one years later *P. Marino* recommended a hydrofluoric acid solution of boron fluoride, potassium fluoride, sodium fluoride or tin fluoride for the same purpose. For the anodic descaling of silicon-containing iron alloys for transformer and dynamo plates, German Patent 748,750 recommends a bath consisting of concentrated HCl, 40% HF, and water. The conditions are a current density of 50-375 A/ft² at 5 V. for 1-8 minutes.

Miscellaneous Acid Pickling Baths

According to U. S. Patent 2,092,130 material is anodically treated in a 0.1-15% HNO_3 bath at a current density of 185-280 A/ft² in order to passivate the surface. The treatment is continued until the metal surface is clouded with bubbles, and it is later depassivated by treating with 5-38% HCl.

U. S. Patent 2,109,675 recommends the removal of surface impurities by a normal pickling process followed by an anodic treatment in 5-15% nitric acid with a current density of 65 A/ft² for 1-15 seconds. Through this treatment the absorbed hydrogen is removed by the pickling bath and hydrogen embrittlement is eliminated. As an example, cold rolled steel was pickled in 10% HCl to remove the scale and then anodically treated in a 10% HNO_3 solution at a current density of 65 A/ft².

U. S. Patent 1,870,096 recommends a solution composed of 4.5 lbs. of HCl (d. = 1.15), 2.2 lbs. of conc. H_2SO_4 and 20 lbs. of water for anodic pickling. The work is treated in a cathodic degreasing bath before and after the anodic treatment.

In U. S. Patent 1,916,503 the pickling of carbon steel in two steps is recommended. First the work is pickled in 50% HCl (d. = 1.18) or in dilute sulfuric acid for five minutes at a current density of 90-190 A/ft² and then treated in a solution containing 200 g/l. CrO_3 and 2 g/l. H_2SO_4 at 45-140 A/ft².

According to *R. Pflucker* (7) stainless steel may be pickled in a solution of 65 lbs. of HCl and 150 lbs. of water with a potential of 80 volts, using a common iron plate for a cathode.

U. S. Patent 1,658,222 recommends anodic pickling in 17-100% phosphoric acid for one minute at a current density of 95 A/ft² and at 125-212° F. The cathode is composed of carbon, chromium or Duriron.

German patent 654,419 recommends a solution of phosphoric acid, chromic acid and chromates for descaling, or for removing solder from iron pieces. By this treatment one gets simultaneous phosphating. The cathode is sheet copper.

Weakly Acid or Neutral Pickling Solutions

It has already been made apparent that it is not necessary to use strong acids for anodic pickling, since the pickling action is not determined by the cation (H^+) but by the anion in solution ($SO_4^=$ or Cl^-). Therefore in anodic pickling, it is possible to use weakly acid or even neutral salt solutions. Although neutral solutions are suitable, a weak acidity in the solution is still desirable. Sulfate seems especially suitable as a starting material for the solutions. Solutions of ferrous sulfate retain a pickling action even in a spent bath, as regards acid content.

At the turn of the century U. S. Patent 568,412 recommended the use of a weakly acid solution of ferrous sulfate for anodic pickling, which process allows the recovery of the dissolved iron on the cathode. Ferrous sulfate or chloride solutions containing a little acid were also suggested in British patent 9,757.

We are indebted to *R. Muller* and *L. Harant* (8) for a systematic survey of the pickling processes using acid ferrous sulfate. On the basis of their review, the authors recommended a solution which contains about 0.4 N $FeSO_4$ and 0.1-0.5% H_2SO_4 for anodic pickling. The current density should be 5-10 A/ft², the temperature 75-95° F., and the pickling time about thirty minutes. The pieces should be moving. This solution should act essentially as a 10% sulfuric acid solution since the ferrous sulfate becomes ionized at the anode, and it has the advantage that it does not form a dark anode sludge as does sulfuric acid. Also, no high polarization potential is apparent, and it should be especially economical to work with a current density of less than 10 A/ft². By pickling with a high current density the time is not shortened sufficiently to justify the higher current consumption. It is conversely economical to work with a low current density in spite of the decreasing metal loss at the anode with increasing current density. In practical tests, descaling of sheets having 5 g/ft² of scale using a current density of 5-10 A/ft² required about 1 watt hour while with a current density of 375 A/ft² 15-20 watt hours were required. Taking the former current consumption as a basis, it appears that electrolytic pickling is somewhat more economical than chemical pickling since the electrolyte is inexpensive and has a long life. By raising the bath temperature, the pickling time can be materially shortened. This temperature effect is less pronounced if the acid content is increased. The superimposition of alternating current retards the pickling process slightly and promotes anodic metal solution. Concentrated ferrous sulfate solutions should be more suitable for pickling chrome-nickel alloys.

French Patent 444,324, recommends pickling in weakly acid solutions of NaCl, $MgSO_4$, NH_4Cl, $(NH_4)_2SO_4$ or $NH_4Al(SO_4)_2$ with either direct or alternating current.

German Patent 277,793 (Austrian 59,967; French 442,868; British 9,609 and U. S. 1,041,790) describes the pickling of wire and tape in a concentrated sodium chloride solution at a temperature of 85-160° F. and a current density of 280 A/ft².

British patent 245,170 suggests using a bath of sea water for anodic pickling, the material being pretreated according to British patent 131,455.

German patent 112,341 (Austrian 1,461; British 19,785) proposes the use of a solution of sodium sulfate for the anodic pickling of iron. This forms iron hydroxide which is continually removed by filtration of the bath. Zinc and aluminum are cathodically treated in this same bath. The other electrode is composed of iron or carbon.

An anodic treatment of iron and steel in an alkaline thiocyanate solution has also been recommended for cleaning (9). The pieces are then treated in an acid bath suitable for the removal of iron oxides.

U. S. patent 1,305,213 recommends regeneration of spent pickling solutions by an anodic treatment of the solution using an insoluble anode. In this manner ferrous sulfate is converted to ferric sulfate and precipitated by hydrolysis, with the simultaneous liberation of sulfuric acid. Manganese compounds are added to catalytically accelerate the oxidation. The operation is conducted at 175° F. or preferably at the boiling point. In this process brown ferric sulfate is formed, while, according to another discovery of the same inventor, oxidation of the spent bath by bubbling air through it forms a red basic iron oxide. In regenerating the bath the work to be pickled may be used as iron cathodes, thus reducing the scale layer.

Alkaline Pickling and Fused Baths

Anodic pickling in alkaline solutions is used mostly for alloy steels and aims at removal of the oxide from the metal surface by vigorous oxygen evolution or by conversion of the oxide to a higher more soluble valence stage. Experience has shown that this allows the removal of the tightly clinging oxide from chrome steel, which can only be done with difficulty by the normal chemical pickling processes. The normal pickling processes in HCl,H_2SO_4, or HNO_3 as well as combinations of these acids with or without an electrical current, generally subjects the metal surface to attack or spoils it in other ways. Anodic treatment in alkaline baths avoids these deleterious actions of the acid baths.

As early as 1925, *Tito Roselli* in British patent 228,278, suggested using solutions containing at least 15% of alkali hydroxide for cleaning stainless steel. The treatment should be carried on for one hour at a current density 45 A/ft². The oxide is converted to a more easily soluble form.

Tool steel was anodically treated in a bath containing 115 g/l. NaOH and 15 g/l. citric acid at a current density of 25 A/ft² by *R. R. Rogers.* (10) The pickling was complete when the gas evolution became uniform. The pieces were then washed and repickled by a short dip in HCl. Tungsten dissolves relatively easily when anodically treated in an alkaline bath while it is only difficultly soluble in the previously mentioned hydrofluoric acid etch. This electrolytic process has the advantage that a very clean metal surface is obtained in contrast to that obtained in the usual acid process. Moreover, the electrolytic bath is more easily handled than the hydrofluoric acid.

For descaling and silver-whitening of stainless steel, an anodic pretreatment in a solution containing 10-50% of alkali or alkaline earth hydroxides is recommended in U. S. patent 1,978,151. Through this treatment the scale layer is loosened, then later removed by a treatment in 5-10% HNO_3 containing a small amount of HF. In order to remove the very tightly adhering oxide and scale layers which are formed by hot working high and medium content chrome alloy steels, German patent 714,056 recommends anodic treatment in an alkaline bath or in fused alkali hydroxide. This treatment converts the oxide of the alloy to a material of higher valence stage and then it is dissolved in 5% sulfuric acid at 125° F. The

green chromic oxide is converted to chromic acid. The melting point of the fused bath may be lowered by the addition of sodium nitrate or nitrite. The residue of the bath left on the wire or tape has the advantage that it may be removed mechanically by squeeze rolls. The iron tank used is connected to the cathode in pickling. The oxide or salt formed is dissolved by following the alkaline treatment with a short cathodic treatment in dilute acid, the time varying from a few seconds to one minute. The anodic treatment is conducted at 400-500° F. at a current density of 10-100 A/ft² for one half minute or longer.

U. S. patent 1,954,473 describes descaling of chrome steel pieces in an alkaline phosphate solution which also contains salts of lead, tin, zinc or cadmium. These metals were introduced as salts or by temporarily hanging the appropriate metal anodes in the bath. While the mode of action of zinc, tin and cadmium is unclear, the action of lead is explained in the following manner: the lead is converted to PbO_2 at the anode and as such, favors the cathodic oxidation of the metals such as chromium, manganese, tungsten, vanadium and molybdenum. A layer of insoluble iron phosphates is formed on the clean surfaces, which hinders the passage of current at these places, thus the current is diverted to the still uncleaned areas of the work. Before hanging the stainless steel in the solution the oxide appears to be blue, steel-gray or reddish orange. In this treatment the scale is loosened by selective dissolving out of the alloying metals and is converted to a brown residue. This residue, which is composed of iron oxides and phosphates, may be removed either by brushing or by cathodic treatment. For example, pieces are treated anodically for 2-5 minutes in a solution composed of 45 g/l. Na_3PO_4. $12H_2O$, 22.5 g/l. Na_2CO_3, and 22.5 g/l. NaOH at a temperature of 175-190° F. and a current density of 3.3-6.6 A/dm² (potential 3-6 V). This is followed by a cathodic treatment in the same bath for 2-5 minutes at a current density of 30-60 A/ft². The removal of the brown residue may also be accomplished in an acid bath according to U. S. patent 1,776,671. The residue is removed by the hydrogen evolved and then a thin layer of lead is deposited on the surface. This film is easily removed by dipping in nitric acid, or in a bath described in U. S. patent 1,857,527.

French patent 875,732 recommends the following several stage process for cleaning iron pieces prior to galvanization;

a. Electrolytic degreasing of the work cathodically.
b. Treatment in HCl.
c. Cleaning anodically in an alkali cyanide solution.

The material is washed with water after each step.

Cathodic Pickling

Fundamentals and Chemical Attack

As already mentioned in Section II, cathodic pickling depends upon the liberation of hydrogen upon the metal surface. We have already learned about the corresponding action of oxygen in the last section. The loosening action of hydrogen, however, is greater since with the same current consumption twice as much hydrogen is theoretically available as oxygen. In practice this difference is still greater since the hydrogen evolution is steady, but the oxygen evolution in acid solutions is only 100% efficient under specific conditions. One particular disadvantage of cathodic pickling is the possibility of hydrogen embrittlement. The chemical attack of the pickling medium upon the metal may be suppressed by the use of inhibitors. *W. Baukloh* and *I. Karnath* (11) determined the influence of inhibitors upon the pickling of steel plates, especially determining the hydrogen absorption of this process. The authors produce proof that the hydrogen absorption and permeability in electrolytic pickling depends largely upon the surface of the work. The work was done in 0.1-1% sulfuric acid. The hydrogen absorption was determined by the change in the ability of the plates to be deep drawn. Two inhibiting agents were tried. One showed little improvement in deep drawing over a pure acid bath, while the second gave a slightly better value. Both agents compensated for the harmful effects of arsenic in the bath to about 50%. The hydrogen absorption was increased appreciably in the presence of arsenic, sulfur and phosphorus, while it was reduced in the presence of lead and tin. This research shows that inhibitors in electrolytic pickling processes can act favorably when we succeed in finding the right inhibitor. Hydrogen absorption can be quite well suppressed by the addition of strong oxidizing agents such as potassium dichromate to either pure acid baths or electrolytic pickling baths.

In a similar manner, *W. Machu* and *O. Ungersbock* (12) determined the influence of an electric current upon the attack of iron by acids in the presence of inhibitors. By experiments with inhibitors whose active constituent in acid solution is the anion, it has been shown that organic inhibitors do not act only on the cathode according to the theory of Machu, but on the anode as well. This is brought forth by the course of the current potential curve and the weight loss by acid corrosion. Although dibenzyl sulfoxide behaves as an anion in acid solutions, its effectiveness on the cathode is significantly greater than on the anode. The polarity, therefore, seems to influence the effectiveness of the inhibitor only slightly. The inhibitors when used in the conducting medium process also decrease the solution of the metals in the acid. In no case can a simple superimposition of the weight loss curves for anodic and cathodic treatment be established.

German patent 740,431 claims that the acid attack of the meal in pickling can be reduced by cathodic pickling with a current density of less than .50 A/ft², preferably under .10 A/ft², in the presence of an inhibitor. The concentration of inhibitor should be one-tenth to one-hundredth of that used in a pure chemical pickle. The current density and weight of additive are dependent upon each other so that when a smaller amount of organic additive is used the current density must be raised, and conversely. This process is also applicable to stainless steel.

According to *R. Liebetanz*, pickling cathodically in a bath containing 100-150 g/l. H_2SO_4 does not give embrittlement when the appropriate additive is used; i.e. condensation products of imido thio carboxylic

acid or its derivatives, with an aldehyde such as formaldehyde. With a current density of 0.03-0.09 A/ft² and by the addition of 0.003-0.05 of such an additive, only 0.17-0.25% iron is dissolved after a cathodic treatment of several hours in 10% sulfuric acid.

Sulfuric Acid Pickling

The preponderant majority of proposals for cathodic pickling baths refer to sulfuric acid solutions. British patent 21,299 recommends cathodic pickling in dilute sulfuric acid with a potential of eight volts. Carbon anodes are used.

U. S. patents 827,179 and 827,180 recommend pickling in sulfuric acid solution of specific gravity 1.06-1.25, to which SO_2 may be added if necessary. The treatment is done at a temperature of 140° F. and a current density of 3.5-6.5 A/ft² for two to three minutes.

British patent 17,672 suggests working in pickling baths composed of dilute sulfuric acid with a current density of 185 A/ft² and using lead or carbon anodes.

U. S. patent 855,677 recommends the use of sulfuric acid (sp.g. 1.20) containing sulfur or powdered pyrites at a temperature of 140° F.

U. S. patent 1,430,844 suggests working in dilute sulfuric acid without an external current source in contact with a zinc plate.

U. S. patent 1,347,897 recommends cathodic pickling of copper material in dilute sulfuric acid solutions. Supplementary cathodes of copper which are simultaneously hung in the bath serve for the electrolytic deposition of dissolved copper.

U. S. patent 1,995,192 refers to the removal of scaly surfaces from hardened iron and steel objects by a cathodic treatment in 10-15% sulfuric acid at 110-120° F. and a current density of 50-60 A/ft². The treatment should last about twelve minutes. The anode is composed of lead. The material is later treated in a solution of sodium hydroxide and trisodium phosphate at 195° F.

As early as 1909 bisulfate solutions to which more sulfuric acid was added were suggested for cathodic pickling, (U. S. patents 939,223 and 939,224). This idea was brought out again in U. S. patent 1,950,689. The material is pretreated by mechanical working which partially loosens the scale. A further development of the same idea is presented in German patent 682,735 which recommends the use of acid salts of alkali metals or ammonia for pickling iron or steel and gives the following example: pickle in a bath containing 150-300 g/l. $NaHSO_4$ or NH_4HSO_4 at 140-165° F. and a current density of 35 A/ft². The loosened scale must be removed from the bath from time to time.

The Bullard-Dunn Process

The Bullard-Dunn process, which also depends upon treatment in sulfuric acid solutions, is so well known and widespread in the technical world that it is only mentioned here for the sake of completeness. According to U. S. patents 1,917,022, (British 353,489), 1,775,671, 1,898,765, German patent 558,022, Austrian patent 127,366, and Swiss patent 147,172 the work to be cleaned is handled cathodically in a 10% sulfuric acid solution to which has been added 18.75 g/l. sodium chloride and a small amount of lead or tin salts. It is treated at a temperature of 140-175° F. and current density of 95 A/ft² (at 6 V) for five to ten minutes. A vigorous hydrogen evolution takes place and drives off the clinging oxide impurities such as rust and scale, leaving the underlying metal free. A thin layer of lead or tin is then deposited immediately upon the clean metal surfaces, thus protecting the metal from further action by the bath. The hydrogen evolution is stopped on the lead or tin coated surfaces because of the higher overvoltage of hydrogen on these metals, thus diverting the current to the still uncleaned surfaces of the work. In this way all of the depressions and cavities are reached by the cleaning process. Even porous deposits of tin and lead protect the metal against further pickling by the bath, since there is always a thin continuous layer of metal under the porous deposits. Excessive hydrogen absorption through long treatment of the work in the pickling bath is not to be feared in this process, and the material may be left in the bath long enough to effect complete scale removal.

After the descaling operation, the lead or tin is removed by anodic treatment of the pieces in an alkaline bath. If the pieces are not to be used at once, the lead or tin layer is left on as a protection against rust.

The bath is controlled by analytically determining the acid, lead or tin, and the iron content. The iron sulfate content of the bath gradually increases because the loosened scale is gradually dissolved by the acid bath. When the content exceeds 45 g/l. the bath must be diluted and regenerated or recharged.

The presence of ferric ions hinders the formation of the protective layer of lead or tin on the clean pieces. In order to hinder the continuous formation of these ions on the anode, British patent 428,712 (German 650,191) recommends the use of anodes containing about 13% silicon (Duriron). A chemically inert layer of silica is formed on this anode which possesses a negligible electrical resistance but which hinders the diffusion of metal ions from the surface, therefore eliminating the continuous formation of ferric ions. This film formation starts at a current density of 35-95 A/ft² in 10% acid. One such anodically formed silicon-iron electrode can also be used as a cathode whereby the diffusion of the cations to the electrode surface is hindered.

Various Electrolytes

German patent 323,066 (Austrian 82,872 and British 14,230) recommends cathodic pickling in 10% phosphoric acid or solutions of trisodium phosphate in phosphoric acid at 140-160° F.

U. S. patent 1,572,583 recommends electrolytic pickling of iron and steel pieces, by first giving a cathodic treatment in an acid bath and then an anodic treatment in alkaline solution. In contrast with this, U. S. patent 1,442,243 recommends first an anodic degreasing in an alkaline bath, followed by a cathodic treatment in a solution containing 5% HCl, and 5% H_2SO_4 for five to ten minutes at a current density of

185 A/ft² at 4-6 volts. Nickel or carbon anodes are used.

For cathodic pickling of stainless steel prior to gold plating, a 25-30% HCl solution is proposed in U. S. patent 2,039,327.

R. Saxton (14) suggests cleaning metal surfaces in baths of molten sodium salts. The sodium liberated reduces the iron oxide, thus by this process no iron is dissolved and no hydrogen is liberated. This treatment may be combined with the simultaneous heat treatment of steel in so far as the melting point of the salt will allow it. The plates so pickled are less inclined to corrosion than those acid pickled.

Pickling With Changing Polarity or Alternating Current

Pickling with changing polarity or alternating current (extremely rapidly changing polarity) is designed to combine and appreciably strengthen cathodic and anodic pickling.

High chrome steel has been pickled by *H. Prelinger* (15) by alternating anode and cathode. If the polarity is changed every two minutes the steel is scale free in a total of ten minutes. During the anodic connection the scale is dissolved while during the cathodic period the scale is forced off by the hydrogen evolved.

Sulfuric Acid Pickling

Several processes recommend first pickling cathodically, then later removing the embrittlement by anodic treatment. For this purpose U. S. patent 1,374,552 suggests sulfuric acid of specific gravity 1.20 while U. S. patent 1,417,896 (German 347,219 and Swiss 96,676) suggests a solution containing 10% H_2SO_4 and 5-10% $CuSO_4 . 5H_2O$. In this process, which serves as a preliminary treatment of the pieces prior to galvanization, the operation is conducted at 140-460 A/ft² at a potential of 8-20 volts.

U. S. patent 1,865,470 proposes first treating cathodically in 2-20% sulfuric acid at 195° F. and a current density of 10-140 A/ft² then anodically in a 40-50% sulfuric acid solution at 85-125° F. and a current density of 75-185 A/ft².

German patent 75,265 (British 244) suggests many polarity changes per minute using dilute sulfuric or hydrochloric acid for the bath.

U. S. patent 2,045,581 recommends pickling the pieces in a basket of a conducting material using alternating current, in a bath of 3-10% sulfuric acid at 140-195° F. As a wetting agent, 0.5-10% gluconic acid or licorice extract may be added. The current density used is 1-10 A/ft².

In order to remove the danger of pitting of rust- and acid-resistant steel that is exposed to the action of halogens, German patent 705,977 suggests electrolytic pickling after the usual chemical pickling, and subsequent passivation of the surface with HNO_3. The electrolytic pickling was conducted in a solution which contains 4% or more sulfuric acid and 278 g/l. $FeSO_4 . 7H_2O$ at room temperature and 10/A ft.² It is especially advantageous to periodically reverse the current so that the work is alternately treated as anode and cathode, but the final treatment before removal from the bath should be anodic. Because of its stability, austenitic 18/8 steel is used for the other electrode.

To remove the oxide layer from copper objects, a cathodic reduction of the oxide in 40% sulfuric acid followed by anodically dissolving the residual copper slime is proposed in German patent 567,264. This is conducted at a current density of 42-95 A/ft² at a potential of 2-2.5 volts for one minute. According to U. S. patent 1,773,160 the same objective is attained in a few seconds by an alternating current treatment in dilute sulfuric acid. The loosened oxide is easily washed off.

Alkaline Pickling

U. S. patent 1,600,355 recommends alternating anodic and cathodic treatment in hot lye.

U. S. patent 1,337,718 proposes alternating treatment in solutions of KCN or NaCN and KOH or NaOH and Na_2CO_3 with sugar, tartrates or citrates to obtain a glossy surface.

According to German patent 741,666, pieces of iron or steel are easily cleaned if they are treated first cathodically then anodically in the same bath in which is suspended supplementary electrodes. The cycle may be repeated. The bath is composed of sodium hydroxide solution. German patent 749,286 suggests a further development of this process which first involves a cathodic treatment in a cathode bath then anodic treatment in a second bath. Both baths are alkaline.

Various Pickling Agents

British patent 3,373 recommends treatment with alternating current in solutions of chlorides, sulfates, or nitrates. Magnesium sulfate should be particularly effective. The work is hung in both electrode positions.

Dilute solutions of phosphoric acid or aqueous solutions of phosphoric acids and phosphates are used in the alternating current treatment proposed in British patent 101,667. The other electrode is composed of carbon.

British patent 305,036 recommends that the material to be pickled be first treated cathodically then anodically in a bath composed of sulfuric acid, phosphoric acid and sodium sulfate.

According to U. S. patent 1,839,488 the work is treated with alternating current, in a bath of dilute hydrochloric acid to which some formaldehyde has been added. In a like manner, Austrian patent 150,280 suggests the addition of reducing agents of organic nature for electrolytic pickling solutions.

In German patent 671,218, pickling is done in 1:1 HCl. Multiple pole changes are used at a current density of 5-10 A/ft² but not over 10 ampere minutes per square decimeter are used. In this case the cathodic treatment is shorter than the anodic, the cathodic current component acting for 2-15 sec. and he anodic for 5-20 sec.

According to German patent 514,157 the action of the alternating current can be increased in electrolytic pickling, by superimposing direct current. In this connection it is interesting to note that according to *Muller and Harant* (8), anodic pickling with direct

current is hindered by the superimposition of alternating current.

Pickling in a Conducting Medium

The conducting medium process of galvano technique is characterized by the fact that the work to be treated is suspended in an electrolyte between the electrodes and without direct connection to the current. One would expect that in this type of pickling the side of the work turned toward the anode would be cathodically pickled and vice versa. This is not the case according to the findings of *O. Ungersbock.* (17) Rather, un-uniform and one-sided pickling is avoided by the formation of a number of anodic and cathodic circuits on the surfaces of the work. This type of electrolytic pickling appears promising for several fields of application and deserves notice from the technical world.

The first proposal of this type of pickling was made in 1913 in Swiss patent 64,944 (French 458,524 and U. S. 1,098,338). The materials to be pickled were suspended between the electrodes in a basket without current connection. The electrolyte was composed of NaCl, Na_2SO_4, $NaNO_3$, $Mg(NO_3)_2$, $KAl(SO_4)_2$ or HCl HNO_3, H_2SO_4, HF, HBr. Alternating current or direct current of rapidly changing polarity was suggested.

British patent 434,116 refers to the pickling of wire, tape, or plates by conducting them through a long trough between the electrodes. Similarly, U. S. patent 2,037,633 recommends that stainless steel wire or tape be pickled in 10% phosphoric, sulfuric, or nitric acid, in a bath which has one side connected anodically and the other cathodically.

Separation of the anode compartment from the cathode by a diaphragm is recommended in German patent 664,201, for either conducting medium or anodic pickling. The material is hung in the anode compartment. The proper acid strength can be standardized by regulating the amount of current passing through the bath in a unit time. In this process the catholyte is not as acid as the anolyte and enables a constant metal recovery and regeneration of the pickling liquid. For example, one finds an almost saturated ferrous sulfate solution containing about 5% sulfuric acid in the pickling trough. The anode is composed of graphite; the cathode, of iron plate, is set in a diaphragm of ignited clay. The operation is conducted at 125° F. and a current density of 10 A/ft² at a potential of 8 volts for about twenty minues. The anodically dissolved iron is separated on the cathode plates.

A technical development of this process appears in German patent 708,587. The pickling bath is regenerated during operation since the sulfate is removed from the higher sulfate concentration by cooling to about 68° F. The process is based upon the surprising knowledge that a ferrous sulfate content of 600-700 g/l. does not lengthen the pickling time in electrolytic medium pickling. This possibility does not exist in chemical pickling since the ferrous sulfate content cannot be raised so high. The removal is accomplished by continually circulating part of the bath through a crystallization system and returning the mother liquor to the pickling solution. Simple air cooling suffices for the crystallization system. The process has the advantage that pickling can still be done efficiently even with a free acid content of only 5%.

According to *O. Vogel* (16) a comparison between chemical pickling with inhibitors and conducting medium pickling was made on a large scale in a wire works. The study extended to rolled wire of .21 in., diameter. Each charge had a weight of nine tons. The wire bundles were hung in the pickling bath and were not turned. The current was not alternated. Both baths were held at 140° F. The chemical pickling bath was composed of 72.6 g/l. H_2SO_4 and 367 g/l. $FeSO_4 \cdot 7H_2O$. The electrolytic bath contained 60.84 g/l. H_2SO_4 and 582 g/l. $FeSO_4 \cdot 7H_2O$. Thirteen determinations were conducted on material which had all received the same treatment, and these showed that the pickling time in the chemical bath was more than double of the electrolytic process, 42½ minutes and 19 minutes respectively for one ton of material. The current consumption amounted to only one kilowatt hour per ton of material, and the acid consumption was about 30% less in the electrolytic pickling. A still greater saving was shown in the descaling of plates, where the acid consumption could be reduced from 175 lbs. per ton to 65 lbs. per ton.

Summary

After an introduction and description of the chemical and electrochemical fundamentals for electrolytic pickling, a survey of a large number of pickling processes was given. The processes were separated into major and minor groups according to their characteristics and discussed in their fundamentals.

Although the principle of electrolytic pickling has been known for over sixty years, the practical advances have been made in the last fifteen years.

Even when the advantages of electrolytic pickling over chemical pickling are shown, the opinions of many technical persons are varied. Surely one can expect with certainty on the basis of results and successes up to now, that electrolytic pickling will be reduced to practice much more than is the case today.

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Figure 1. Stainless steel depth sounder parts after blackening.

(Courtesy American Rolling Mill Co.)

Fabricating and Finishing Stainless Steel

CONCLUSION

By Arthur P. Schulze, *Lakewood 7, Ohio*

In this final paper on stainless steel finishing, the author deals with blackening for appearance and additional corrosion resistance, miscellaneous operations such as soldering, brazing and welding, and mechanical and chemical etching. Formulas, methods and operating conditions are listed.—Ed.

FROM the laboratory stage into field usage has emerged a technique of surface-finishing stainless steels chemically which has been relatively far advanced over a comparatively long period for other metals and alloys. But not so for stainless. That production-finishing process is blackening.

The Author

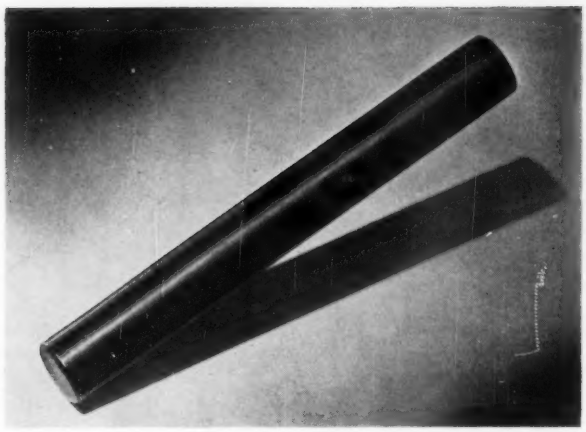
Blackening

Originally designed to answer the wartime call for dulling the finish of stainless steels in certain key military equipment applications, this surfacing development presents many potential peacetime product applications which have a similar need. All of which explains the increasingly keen attention it is drawing from the metal-finishing industry. This is particularly true in view of the fact that now a recently developed, war-tested method reportedly represents the first practical realization commercially of the feasibility of securing durable black finishes on stainless steels.

With the practicability and availability of successfully blackened stainless surfaces thus established as solid certainties by virtue of this process, many forward-looking finishing engineers and product designers undoubtedly will want to investigate the possibilities this new and now patented technique (U. S. Pat. 2,394,899)* presents on two counts. First, for its color value, and secondly, for its added merit of greater endurance of the corrosion-resistant base.[1]

The problems presented in black-finishing stainless steels are, of course, fairly well known and appreciated to a certain degree, but the same cannot be said of the rapid strides which have been made to

* Rustless Iron and Steel Division of the American Rolling Mill Co.



(*Courtesy American Rolling Mill Co.*)
Figure 2. Typical blackened stainless test bar for use in checking light reflectivity and corrosion defiance.

their successful solution. Knowledge on this score is not nearly so widespread. Consequently, a resume of the research and technical development work which have been carried on in this direction should prove of timely interest and constructive value to all those metal-finishing executives anxious to keep abreast of "what's new" in blackening the stainless steels.

Problems in Blackening Stainless

Many attempts have been made from time to time by some manufacturers to blacken stainless steels. The results secured with pigments, enamels, japans, electrodeposited coatings, flame and temper staining have proved discouraging generally, as all of these methods have proved faulty for one reason or another as far as their application to stainless steel is concerned. Failures followed in steady succession due to brittleness, poor adhesion, low abrasion resistance or, most seriously, impaired corrosion resistance. Back in 1943, Dr. W. R. Meyer aptly reviewed the overall problem confronted with methods tried up to that time in a paper printed in the educational proceedings of the American Electroplaters' Society.[2]

Stability of the thin, invisible film of oxides, chromium, iron and nickel that forms on stainless provides the corrosion resistance measure. Compared with the underlying steel, there is marked chromium enrichment in the film which increases in relation to the percentage of chromium in the alloy and the degree of polish. When these oxides are stripped chemically, the film instantly re-forms, continuing its protective action as soon as it again comes in contact with oxygen in the air or some oxidizing condition. And even when this film is machined away, filed off or peened down into the metal, it reforms. Here is the phenomenon that makes the application of coatings, as most people think of them, to the stainless steels a difficult proposition. These coatings just don't want to stick![2]

Owing to the complexity of the oxide components, shifting of the surface film oxides so as to change color and brightness to another color with reduced reflectivity presented a somewhat perplexing problem. The method is limited to electrochemical or chemical means. In approaching the problem, chemists and metallurgists were faced with a seemingly endless chain of varying oxides and almost countless oxide combinations. As can be well realized, determination of how to attain this selective oxidation called for patience and imagination.[2]

Original Approach to Selective Oxidation

The original approach to the problem of burning on an oxide film in a high temperature controlled atmosphere—was found lacking from a practical standpoint. It is explained in brief thusly:[2]

> "Yes, you can change the color of the stainless steels. In certain types of oxidizing atmospheres you can readily cause an alteration in the chemical make-up of the oxide film at high temperatures. As a matter of fact, if you were persistent enough and applied enough heat for a long period you could shift the entire alloy into the oxides of its elements—with a complete loss of its virtues. But if you stopped this process at an intermediate point, you would have effected an apparently successful color change. But it doesn't work out that way. By this all-too-obvious method you would have produced nothing but a porous, brittle oxide which can be readily penetrated with a number of corrosive media—in fact, you would have practically destroyed the corrosion resistance of stainless steels to most media."

How, then, did the metallurgists go about solving this problem? Answer to this question is that they first established their desiderata, as follows:

1. Color that will adhere.
2. Must cause no reduction on corrosion resistance and possibly increase this vital factor.
3. Must be thin and must not change dimensions of a precision part.
4. Abrasion-resistance quality must be kept at highest point possible to prevent coating from easily rubbing off.
5. Coating must be ductile.
6. New blackened skin must not suffer in service from high temperatures in any greater degree than the stainless steels before treatment.

Testing of Coating

That these metallurgists did meet substantially all of their desiderata was clearly demonstrated during the war through exhaustive tests where, in the manufacture of the M-1 (Garand) rifle, the method not only blackened the metal with a durable, non-graying, low-light-reflective coating of 0.00001" in thickness, but also "gilded the lily" as it slightly improved stainless' well-known corrosion defiance.

Equally noteworthy are the severe conditions under which the finish of blackened stainless steels survived on 36 components of the Bludworth Depth Sounder, developed by the International Projector Corporation. There is no need to delve into the construction details of this equipment here; suffice to say, black-finished stainless was subjected to five abuses: (1) salt spray; (2) submersion in sea water; (3) alternate submersion in sea water and air; (4) tropical sunlight; (5)

rough handling at dockside and on board since this equipment is portable.

Examination of test equipment in use over a six-month period under grueling tests showed the blackened stainless, both 18-8 and 12 chrome grades, to have resisted corrosion completely. It showed, further, that under drying abrasive conditions such as on a lashing-post, the color loss did not result in shine but rather in a full glint which did not reflect light to a noticeable degree. And parts subjected to severe abrasion showed no color change when compared with new parts.[2]

Operating Highlights Blackening Technique

Formed in a non-aqueous bath (of molten sodium dichromate, preferably) at moderately high temperature, this new black coating is a metallic oxide, not a hydroxide, which accounts for the unusual endurance of the film upon exposure to heat and atmospheric changes. The blackening exhibits no tendency to turn gray in service over a period of time. And no color alteration was microscopically visible after over a year's exposure to all the galaxy of fumes and gases of a research laboratory.[1]

No elaborate equipment installation is required to attain all the desirable features of this black-finishing technique. A suitable-size tank, an adequate heating method, and work holders or baskets to contain parts during immersion are the only items needed. To assist in maintaining application uniformity of the coating, best practice calls for the use of a cover and stirrer.[2]

In blackening, like so many other metal-finishing and product-coating procedures, it is customary to degrease and clean (and if necesary, descale) parts by the usually accepted methods before treatment. Molten sodium dichromate in the blackening bath, meanwhile, is raised to a temperature between 730°-750° F. As is to be expected, treatment time comprises a variable, which is governed by the number and size of the parts as well as the particular grades of stainless from which they are made.[1]

However, from a study of the chart reproduced below giving operational curves for three of the most popular types of stainless steels . . . 410-12 Cr., 430-17% Cr., 304-18-8 . . . it is evident that stabilization of coating generally occurs in from 20 to 30 minutes' treatment time. Then, following removal from the hot bath, the work is allowed to cool to room temperature and rinsed in hot water. Readily soluble, the salts are easily removed in the rinse. Upon air-drying parts are ready for service.[1, 2]

Use of oils and waxes to improve the luster of the black finish has met with success. Practically all seasoned veterans of metal finishing are well cognizant of the fact that this practice is regularly employed in connection with black oxide coatings on ordinary steels, of course, but for the purpose of protection from rusting more than obtaining a luster. Some engineers claim that ordinary steels which have been black-oxide-coated have no corrosion resistance when the oil or wax impregnation disappears. But this does not hold true in the case of blackened stainless steels since, obviously, they remain highly resistant to corrosive attack even if the black oxide is removed.[2]

This development not only has attained all of the goals set up for it at the outset; this simple, now patented process also has exceeded the technicians' wildest hopes through effecting some improvement of the established resistance to several corrosive media by the stainless steels so treated. The table gives results of tests, again on the same three widely-used alloys charted previously for operational time.

COMPARATIVE CORROSION DATA IN WEAK NITRIC AND HYDROCHLORIC ACIDS*

(Corrosion Rates are expressed as grams/cm²/50 hours)

Test Specimens**	0.5% by wt. HNO_3-boiling	2.5% by wt. HNO_3-boiling	0.5% by wt. HCl-120° F.	1% by wt. HCl-120° F.
12 Cr.	0.0023	0.104	0.993	1.460
12 Cr-Blackened	0.0000	0.008	0.108	0.473
17 Cr.	0.0008	0.0004	2.72	2.940
17 Cr-Blackened	0.000	0.0000	0.0505	0.882
18-8	0.0012	0.0000	0.0193	0.0190
18-8-Blackened	0.0000	0.0000	0.0007	0.0012

**Test specimens were 2" x 1" x .050", with a pickled finish.

CHEMICAL ANALYSIS OF STEELS TESTED

Identification	C	Mn	P	S	Si	Cr	Ni
12 Cr.	0.11	0.43	0.015	0.024	0.35	12.17	0.18
17 Cr.	0.10	0.47	0.018	0.017	0.36	17.48	0.12
18-8	0.05	0.65	0.021	0.015	0.54	18.11	9.18

(Courtesy Republic Steel Corp.)

Figure 3. Grinding circular weld on end of tank made of stainless.

Miscellaneous Operations

Among other operations performed by different plants and shops from time to time in fabricating and finishing the stainless steels that present varied surface preparation or treatment problems of special interest to metal finishers are: soft soldering, silver soldering or silver brazing, welding, and mechanical and chemical etching. A brief review of each operation follows, concluding this final discussion of well-established present-day practices in processing stainless steels as they apply to the metal-finishing industry.

Soft Soldering

Successful soldering of all metals depends on how well the solder adheres to the surface. Soldering is unlike welding where a perfect fusion is obtained between the surfaces to be joined together. It does not alloy with the metal, and if grease or dirt is present, a firm bond is not produced. It is also found that preliminary roughening of the surface by chemical or mechanical means will make a much stronger joint; that is, the rougher the surface, the better the adhesion value.[3]

Proper preparation of the joint surfaces by the application of fluxes is, therefore, essential if liquid-proof seals are to be produced. This is true of any soldered joint, of course, but it is particularly important with the straight chromium and chromium-nickel alloys because of their corrosion-resistant character.[4] Hence, thorough cleaning is required prior to applying the flux.[5]

Mill finishes No. 1, 2-D, or 2-B tin very readily with cut acid or most liquid fluxes. The surface on polished stainless, such as No. 4 or higher finish, should be roughened by the use of emery cloth or grinding wheel to secure the best adhesion. If neither of these is desirable, a solution containing a mixture of 50 parts ferric chloride, 90 parts hydrochloric acid and 3 parts nitric acid may be used for surface-roughening. Solution is applied only where solder is to adhere and allowed to remain for several minutes, after which it is carefully wiped off with precaution being taken to make certain it does not come in contact elsewhere on the part being fabricated. Two to five minutes will generally etch the surface to the proper extent and thus facilitate keying-in of the solder with the base metal in the subsequent tinning and joining operations, which require a stainless steel soldering flux of high-grade quality.[3,4]

Since experience commonly demonstrates that most troubles encountered on soldered joints when poor adhesion is the cause are generally traced to the flux used,[3] selection of a proper flux is decidedly important. It should melt slightly below the melting point of the solder so as to provide maximum protection against oxidation of the sheet and to prevent entrapment of the flux itself. With numerous prepared fluxes for stainless steel commercially available, manufacturers should be consulted as to the proper type and correct usage.[5]

Three types of solder are in common usage on stainless steels: ordinary half and half, 60-40, or block tin. Of these, the first, 50% tin 50% lead solder, is the most widely used as it flows smoothly and adheres well to stainless, giving a good strong joint.[3] But in cases where a stronger joint having greater corrosion resistance is required, the so-called high-tin content solders, which contain approximately 80-85% tin, are preferred.[4,5] Where strength is a dominant factor, 60-40 are usually specified. Many fabricators choose block tin for such requirements in preference to the 60-40 which is claimed to be only slightly better than 50-50.[3]

It should be noted that, in most corrosive media, there is apt to be a difference in potential between the solder and the stainless alloy. This difference is more marked when soft solders are used, and consequently, they may dissolve or corrode more rapidly when used with stainless alloys than with copper or mild steel. Soft solders containing large percentages of lead often turn black quickly in contact with these alloys. Where such a condition is objectionable, pure tin or solders containing only small amounts of lead should be used.[4]

As most stainless steel fluxes are usually highly corrosive by virtue of their hydrochloric acid content, any residue or flux resulting from their use should be thoroughly removed by neutralizing the work immediately with alkaline solutions upon completion of the soldering job. Acid content is a desirable characteristic in a soldering flux; yet every trace of it in the vicinity of the joint or present as spatter on the material should be most carefully removed after the joints are made to prevent local corrosion or pitting from strong fluxing acids. Failure to do this may lead to continued attack on the material with consequent bad results.[3,5]

Cleaning is best accomplished by thoroughly washing the entire part, particularly the joint, with a sal soda solution of 5-10% concentration, using a soft

* Courtesy Rustless Iron and Steel Division, The American Rolling Mill Company, Baltimore Md.

(*Courtesy Republic Steel Corp.*)

Figure 4. Initial grind on bead weld of stainless steel. Note paper applied as protection during welding and finishing.

rag. Another recommendation is to wash the work with ammonia water or water containing a liberal amount of yellow laundry soap and ordinary soda. At times, it may be necessary to employ a scrubbing brush.[4] Thorough final rinsing with water is also essential.[5] Effect of spatter may be reduced by coating the work away from the joint with paraffin or grease.[4]

In view of the fact that thermal conductivity of stainless steels is lower than the nonferrous metals used by most shops, a large soldering iron gives best results. It should be heated just above the melting point of the solder as this will assist in eliminating the buckling or warpage so frequently encountered where a smaller very hot copper is used. The large copper will retain its heat longer with the lower temperature.[3,5]

Silver Soldering—Brazing

The chromium-nickel alloys may be silver brazed, or silver soldered as it is sometimes called,[3] without difficulty. Yet though seemingly paradoxical, this joining method is not recommended as general practice for several reasons.[5]

In view of the relatively high melting point of brazing alloys, this method subjects most stainless compositions to unfavorable temperature ranges, causing carbide precipitation and loss of corrosion resistance. Moreover, electrolytic attack is likely to occur under many corrosion conditions. Physical embrittlement as a result of inter-crystalline penetration may also occur. Finally, pronounced differences in color between the stainless steel and the brazed joint are oftentimes objectionable.[5]

Because of these detrimental factors, brazing is generally confined to applications where stainless sheets must be joined with brass, bronze or similar nonferrous parts.[5] In such applications where ordinary solder bond does not have sufficient strength, silver soldering or brazing has no equal; in all other cases, due to the higher heat and special fixtures required to hold the work, welding is much more desirable.[3,5]

In brazing stainless steels, there are certain rules which, if carefully followed, will consistently give excellent results.[3] First is cleaning. A prerequisite to a good joint is a thoroughly clean metal surface on which the solder is to be applied.[4] It is important, therefore, to clean off mechanically all dirt, grease or surface oxidation from the surfaces to be brazed. Elimination of grease or oil is especially important, and if they have penetrated into the metal, chemical cleaning is recommended. After cleaning, the material should be immediately fluxed to prevent oxidation.[3]

Because of the high temperatures (800°-1500° F.) of the process and the relatively high coefficient of expansion of the chromium nickel alloy, it is important to hold the work in accurate alignment with fixtures. Chill bars to absorb excess heat are also recommended. With the joint so prepared, the next step—application of heat—is done with an acetylene torch.[4]

Flux is added to dissolve oxides formed during pre-heating and is fused on the work, being applied

(Courtesy Republic Steel Corp.)

Figure 5. Final buffing of weld after polishing to obtain high luster.

easily with a brush wherever the brazing alloy is expected to flow. In bringing the work up to brazing temperature, the torch is kept in motion to avoid concentrating the flame on one spot and thereby assuring an even heating at and adjacent to the surfaces to be joined. This prevents overheating the flux as well as the metals being joined.[3]

With flux in proper condition and the metal at correct temperautre, the solder is applied. Following this, the joint should be cleaned up, removing residues of flux or oxides by means of a steam jet or other mechanical methods.[4]

In some cases, flux can be dissolved in hot water, with the result that there is but little clean-up work required and a consequent speed-up in finishing operations.[3]

When brazing stainless steels brazing solders high in solver content prove most suitable for a variety of reasons. Their melting point is fairly low, thus minimizing undesirable structural and corrosion effects. Because they flow readily they greatly expedite the joining operation. The high silver solders are fairly strong, tough, and resist shock and vibration and thus are physically advantageous. And, finally, their color is very similar to that of stainless steels. It is for these reasons that silver soldering is being applied on an extensive scale. In contrast, copper-zinc alloys are much less popular because of their higher melting temperatures, difficult fluxing, different colors, and more pronounced effects on the physical and corrosion properties of stainless materials.[5]

When silver soldering the straight chromium alloys which air-harden upon cooling from above their critical temperatures, it is desirable to employ a solder and a flux that will function below these temperatures. Therefore, with 4-6% and 12% the temperature should be held below 1450° F.; and with 17 and 28% below 1600° F.[4]

Welding

The stainless steels are readily weldable by all methods applicable to carbon steel except hammer or forge welding.[4] These include autogenous, electric arc, electric resistance and atomic hydrogen welding.[5] In recent years welding has extensively replaced other forms of joining and its use is steadily increasing. This type of construction is readily adapted to the stainless steels, especially those containing 7% nickel or more, in addition to 17% or more chromium.[6]

Of all the stainless compositions, the chrome-nickel grades are thus most suitable for welding since they produce not only strong but also very tough welds, a factor that is essential for most applications. Chrome grades do not yield this high degree of toughness and thus are subject to limitations in welding applications. However, with proper technique, these grades develop weld properties entirely satisfactory for many purposes.[5]

It is beyond the scope of this discussion to examine in detail all welding factors, for they have a specialized technical literature all of their own. Insofar as interest of metal finishers in this joining operation is concerned, it is sufficient to point out that prime requisites to successful welding of stainless with all commonly-utilized methods include: freedom of surfaces from any contamination, particularly scale; sufficient pressure to obtain proper contact; correct design of joint and proper type of electrodes; correct set-up for welding, and sufficient electric power and thoroughly adequate means for accurately determining and switching the welding current.[4]

Of special interest from the finishing standpoint, however, is the additional fact that the high temperature employed in electric arc welding, whether on chromium or chrome-nickel, discolors the metal for a short distance on each side of the weld. This is a surface condition only; it is nothing more than an oxide that is easily removed by some form of pickling or by grinding and polishing with abrasive wheels and grits, after which the metal underneath is in the same condition as before welding. In other words, the oxide on the surface does not affect the metal beneath it. If this oxide is not removed and the surface becomes wet and dry, it changes from a blue color to a brown, resembling iron rust, along these areas.[6]

Spot welding, too, like any other type of welding requiring high temperature, forms a blue-colored oxide on the surface. Exposed to the weather or moist conditions, it slowly changes to a rust-resembling brown color. As in the instance previously cited, this is merely a surface condition, affecting the original oxide only. If such welds are to be exposed to the atmosphere, they should be cleaned either with acid, as in pickling, in the case of No. 1 finish sheet, or ground and polished, if No. 4 or higher finishes are employed. In the ground and polished state, spot welds have withstood several hundred hours salt spray without the least sign of attack.[6]

Mechanical Etching

Ornamental panels, name plates and many other similar stainless steel products can be produced through mechanical or chemical etching. Two-tone effects are readily produced on flat articles (architectural trim, name plates, signs, interior trim) by mechanical means. Generally, with this type of work a fairly high polish in contrast to a dulled down finish is desired and may be accomplished in the following manner.[3]

After the sheets are secured from the producing mill in the polished state—either Nos. 4, 7 or 8 mirror finish—the design is masked out with masking tape on the polishing surface. Parts are tampico brushed with a suitable abrasive for several minutes, dulling down the unmasked surface so that removal of mask reveals the design in attractive, pleasing contrast.

The tampico process has been used for quite some time now for producing striped effects, as well as other ornamental work where dulling down only one surface to contrast with the other is desired. The only precaution required is to clean the sheet of any substance which might possibly inhibit the masking medium's adhering qualities.

Sandblasting is another method that may be employed for mechanically etching stainless steel with considerable success. The design is laid out on the sheets as for the tampico brushing technique. Iron-free abrasive of the desired mesh is used; coarseness of the abrasive and the driving pressure of the sandblast determine the amount of dulling down of the original finish. By varying the abrasive, pressures and blasting period on unmasked surfaces, toning down of various degrees can be attained. The mask can also be changed to obtain shading in varied degrees when the sandblast is used.

At the completion of either the tampico brush or the sandblasting operations the surfaces of the work should be thoroughly cleaned of all abrasives so as not to change the higher polished surfaces when the mask is removed by suitable solvent.[3]

Chemical Etching

Procedure for chemical etching of stainless is somewhat more complicated, but much deeper relief between the two surfaces is attainable.

The design, usually laid out on white paper, is photographed and a flexible negative of the desired size made on the film. This design is transferred to a sensitized zinc plate which is then etched to bring it out. After the zinc master plate has been etched to the proper depth it is ready to be inked and the design thereon transferred to a rubber sheet or blanket, which is then placed in contact with the stainless sheet surface and the design thus transferred.

Now that the design has been transferred to the stainless sheet, a suitable resist is dusted on after removal of the rubber blanket. The resist only adheres to the portions that have been inked and after baking the stainless sheet so prepared at moderate temperature to set up the resist, it is ready for etching in the acid bath. A ferric chloric ($FeCl_3$) solution has been found to give good results. Believed the most widely used, it compirses 75% of 40° Baume Ferric Chloride $FeCl_3$ and 25% of Hydrochloric Acid CP (HCl).[3]

This solution is generally employed at 150° F. and etches approximately .005" deep on 18-8 Type 302 stainless alloy in 15 minutes. A 40% solution of $FeCl_3$ can be used cold but is much slower. Addition of 15-25% acid virtually doubles the action, which is further increased by raising the temperature. Care must be exercised to keep the solution on the acid side and free from ferrous chloride or it will pit the stainless surface. All traces of etching solution are then carefully removed by neutralizing the work quickly after etching.

Where more than a mere surface change of color is desired, chemical etching is preferred over mechanical methods. Depth of etching can be controlled by both time element and properly balanced etching solutions. Again, if etched portions are to be enameled, the chemical type of etching presents a surface more suitable for the enamel to adhere to, giving sharper contrast at the edges and less danger of peeling or chipping off when cleaned.[3]

Conclusion

In this series of five articles, attention was first called to the versatility, utility, economy and attractiveness of stainless steel, a remarkable combination of virtues which explains the tremendous development of these alloys from an experimental stage to world-wide acceptance in the short span of two decades. Today, as never before, it is clear that the introduction of stainless has satisfied an urgent need for a new superior metal in the enormous field of application where the qualities of corrosion and heat resistance are of paramount importance. It is also equally apparent today that stainless will continue to grow in usefulness and undoubtedly at an accelerated rate.[5] Stainless steels, therefore, are destined to continue commanding increased attention of and study by metal finishers.

These discussions have presented a considerable amount of technical data on processing compiled for the benefit of stainless steel fabricators and finishers. But the information given represents, necessarily and admittedly, only a fragmentary portion of the wealth of data generally available, as it has not been possible to cover here in complete detail every single phase of fabrication and finishing of interest to metal finishing department superintendents and shop foremen. These discussions have described no novel nor strange methods; they have, instead, simply presented some selective facts and unusual "wrinkles" regarding commonly-used metal-working techniques as they apply in particular to the stainless steels. Accordingly, they should, it is hoped, prove of practical help to the metal finisher in expeditiously handling the increasingly large volume of stainless steel parts and products which he is being asked today to fabricate and finish.

In short, processing stainless is different, not difficult. It should be remembered that because of its high strength and variety of finish, stainless requires the exercise of care in its fabrication and finishing. And with proper equipment and adherence to certain key principles, practices and precautions, such as those which have been outlined in this series of articles covering the highlights of various operations, metal finishers who work with stainless should experience no difficulty.

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PLATING AND AIRLINES EFFICIENCY

(*Concluded from page 94*)

ring is made of lead for the lead bath, and of stainless steel for the indium bath. Figure VI shows this assembly immersed in the plating tank.

Batch plating of small inner areas in a complex housing is illustrated in Fig. VII. This arrangement avoids immersion of the housing in the plating bath. The operator pours cadmium solution into the cavity and replenishes it at regular intervals as it becomes used up.

In chrome plating, many specialized devices are also used. Shown in Fig. VIII is an experimental study of a frame from which the plating jig is suspended for hard chrome plating selected areas of a critical operating part.

Another indication of the great diversity of jobs that are handled in this shop can be obtained from Fig. IX. This shows a crankshaft bolt that is silver plated on one end and tin plated on the other. Masking tape is used to stop off the end which is not being plated. There are a large number of parts that get this dual type refinishing.

In spite of the complexity of jobs and parts, the special jigs required, and the small quantities of each part that are refinished at a time, this shop, through a well-planned engineering approach to the problems and a rigid follow through on the detailed specifications has managed to maintain an orderly and systematic plating shop, and the cost of finishing the highly critical parts of aircraft engines has been kept at a level that is usually only possible in mass production shops.

Chromated Protein Films Inhibit Corrosion

CHROMATED protein coatings* offering a convenient, inexpensive means of protecting metals—especially zinc, iron, brass, and aluminum—during outdoor storage in mildly corrosive atmospheres have been developed by *Abner Brenner, Grace Riddell,* and *Robert Seegmiller* of the *National Bureau of Standards.* The protective value of such films is somewhat better than that afforded by chemical surface treatments and is much superior to that of corrosion-inhibited oils and waxes. The metallic surface to be coated is first dipped in casein, albumin, or gelatin; the resultant film is then impregnated with chromate, which both hardens the film and inhibits corrosion.

The wartime scarcity of many nonferrous metals led to the extensive substitution of ordinary carbon steel for copper, brass, aluminum, and stainless steel in both military and civilian uses. While the steel was generally protected with zinc coatings, the tendency of the zinc to form objectionable corrosion products brought about a widespread use of chromate films on the zinc. These films were formed on the surface by chemical attack in aqueous chromate solutions and, though only a few hundred thousandths of an inch thick, were useful in inhibiting corrosion. However, as this was apparently due to the presence of minute amounts of soluble chromate, slowly liberated by the action of moisture, it seemed possible that an enhanced corrosion resistance might be obtained by applying a large quantity of chromate to the metal surface. The National Bureau of Standards therefore undertook an investigation in which proteins were found to offer a good medium for increasing the amount of chromate on the metal surface since they are basic and readily absorb or combine with chromic acid. Although initially developed at the Bureau as a substitute for chemical surface treatments of zinc, the chromated proteins are also of value in protecting aluminum, steel, brass, and other metals.

The principal constituents of the chromated protein films are a corrosion inhibitor for the metal, a protein which acts as a vehicle for the inhibitor, a hardening agent, and a bactericide to prevent putrefaction of the protein. The chromate always serves as the inhibitor and may act as the hardening agent and the bactericide as well. However, other materials such as formaldehyde, tannins, or certain salts of the heavy metals can be used as the hardening agent.

The four functioning constituents of the film can be applied in a single step or in several steps, according to the compatibility of the agents and the degree of protection desired. In the "two-step" process, which is usually the most satisfactory, the metal is first dipped into an aqueous protein solution. When the resulting protein film is dry, it is immersed in an acidified chromate solution for one-half to three minutes and allowed to dry without rinsing. The preparation of the protein solution varies somewhat with each protein. Gelatin is dissolved in water by heating gently; albumin may be dissolved in water at room temperature by stirring; casein is dispersed in water and brought into solution with the addition of 25 ml of ammonium hydroxide per liter of solution. The chromate solution contains chromic acid (0.5 to 2 percent) or a dichromate of zinc, iron, or nickel (1 to 10 percent).

A simpler "one-step" method of forming the inhibiting film by a single immersion in a solution containing both the protein and the chromate has the disadvantage that the solution slowly deteriorates. A solution of this type is made by adding ammoniacal zinc chromate to a solution of casein. The resulting preparation should contain about 10 percent of casein and the equivalent of about 5 percent of zinc chromate.

The chromated protein films are yellow and, unless opaque pigments have been added, are transparent. Their flexibility and adhesion are sufficient to prevent cracking or separation when the metal is bent. They are not injured by heating to 150° C, whereas most chromate films produced chemically on zinc lose much of their protective value at 100° C. Thickness depends principally on the concentration and viscosity of the protein solutions, varying with the type of protein up to about 0.0002 inch. This is in contrast to the proprietary chromate films, which usually are not more than 0.00003 inch thick.

When freshly prepared and hardened, the films are almost insoluble in water and are so hard that they cannot be scratched with the finger nail. Exposure to light further hardens some films and renders them still less soluble. However, the films may be quickly removed from metal parts by application of an alkaline solution such as 5 percent sodium hydroxide. Their removal is thus more convenient and less hazardous than the removal of oil films with toxic or inflammable organic solvents.

The protein solutions, unlike the baths used for direct phosphate or chromate treatments, do not become exhausted and require replenishment, but are fairly stable for long periods. While chromated protein films are superior to direct phosphate or chromate coatings or to oil films for corrosion prevention, their life is less than that of suitable paint coatings. They are more effective on large, regular surfaces than on the sharp edges and corners of small objects like nuts and bolts, where the film tends to pull away.

* For further technical details see "*Chromated Protein Films for the Protection of Metals*", by *Abner Brenner, Grace Riddell,* and *Robert Seegmiller,* in *J. Electrochem. Soc.* for March 1948.

Shop Problems

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Preparation of Copper Lactate

Question: I am in need of some copper lactate for a metal coloring bath I wish to try out, but have been unable to purchase this material. Can you tell me where I could obtain some?

M. L. I.

Answer: Copper lactate can be made by using copper carbonate and lactic acid, both of which are readily obtainable. They should be used in the proportion of two parts of lactic acid to one part of copper carbonate.

Removing Rust from Machinery

Question: I have some small machine tools on which rusting has occurred, as on the tailstock, shafts, and slides. Do you know of a solution that can be rubbed on these surfaces to remove the rust without damaging the machines?

H. H. M.

Answer: Several firms make rust-removing preparations that can be used in just the manner you mention. We are sending you a list of these firms. As a precautionary measure, we would advise thorough rinsing and wiping after using the rust-remover, then using a coating of light machine oil for further protection.

Hard Finish for Tubular Parts

Question: We have been using cadmium plate on a tubular metal part, but after some use the plating was worn through due to rubbing against a cloth with which it comes in contact. Can you suggest something better?

M. C.

Answer: Either nickel or chrome plating will give your parts a much harder and wear resistant surface. Both of these metals can be plated successfully over stainless steel provided care is taken in the preliminary cleaning stages to insure a surface that is chemically clean.

Oxidizing Silver Plated Parts

Question: Can you give me the formula for a solution that can be used for producing an oxidized finish on silver plated pins? I am not interested in the formulas using platinum salts.

E. W. B.

Answer: Solutions that may be used for oxidizing silver are as follows:

1) 10 grams Liver of Sulfur
1 liter of Water

The solution should be heated to about 80°C. and the parts immersed until the color is fully developed.

2) a—1200 grams Iron Chloride
1 liter water
b—20 grams Caustic Soda

Dip parts first in (a), rinse well, then dipped in (b) in contact with a piece of zinc metal. This gives a brown-black color.

Stripping Rolled Gold Plate

Question: I am interested in stripping the gold from rolled gold plated parts and would appreciate any information you could give me regarding the process.

S. H. W.

Answer: Stripping the gold from rolled-gold plate is not possible without also dissolving the base metal contained in the alloy. Rolled gold plate is not pure gold, but an alloy with copper, and any method for removing the gold would also remove the copper contained in the metal. The only practical way to recover the gold from this type of material is to melt the alloy down and send it to a refinery that specializes in this type of work. A list of firms that might be interested in doing this for you is being sent to you.

Plating for Heat Reflectors

Question: We are making a part that must reflect heat, and require a surface that will retain a luster when operated at 400-600°F. Can you suggest a material that we could use?

C. W. S.

Answer: We believe that a chrome plating over a fairly heavy nickel deposit that has been highly buffed will suit your purpose. We recommend at least .0005 in. of nickel, followed by about .00005 chrome would be satisfactory. In the event that this does not give sufficient life, your next best bet would be a light gold plate over a nickel deposit.

Immersion Tin Deposit on Copper

Question: We have recently been asked to deposit tin on copper by the "cream of tartar" method. Can you furnish us with details on this process?

J. L. O.

Answer: The "cream of tartar" solution is made up as follows:

10 grams Cream of Tartar
1 gram Stannous Chloride
1 liter water

Parts are immersed in the boiling solution in contact with a piece of pure Zinc metal. The deposits of Tin are bright, but very thin.

Recovering Metals from Dummy Cathodes

Question: We use dummy cathodes on our plating conveyor, and over a period of time these build up a sizeable amount of copper and nickel plating in alternate layers of about .0003 in. copper and .0008 in. of nickel. We have accumulated a large amount of this material, and would like to know if there is some way these metals could be used or recovered?

H. M. C.

Answer: About the only way to re-

cover the copper and nickel from your cathodes would be to ship them to a refiner of metals, where they could be melted down and used for making up copper-nickel alloys, such as monel or nickel silver. This would only be practical if your dummy base metal was copper or brass. If the base metal is steel, there would probably be too much contamination by this metal when the cathodes are melted down. Another important consideration is whether or not there is any chrome present in the deposits, as this would also be an undesirable impurity.

Auxiliary Anodes for Chrome Plating

Question: I am in doubt as to the correct hook-up when using auxiliary anodes, and the distribution of the current. Can you help me out on this?

P. B. G.

Answer: Exact recommendations on the use of auxiliary anodes is difficult to make, as every set-up requires some experimenting to arrive at the optimum conditions for a good deposit. The auxiliary anodes should, of course, be connected to the anode rod and insulated from the rack and cathode (work) rod. Quite frequently when using auxiliary anodes no other regular anodes are necessary, but again this can only be determined by trial and error.

Acid Dipping Before Chrome Plating

Question: Is it always necessary to use an acid dip after electrocleaning before chrome plating?

B. P. G.

Answer: In order not to drag alkaline materials into the chrome bath, an acid dip should always be used, followed by thorough rinsing. If muriatic acid is used for this dip, two rinses are best, while with sulfuric acid dipping only one is required provided it is thorough. While it is not desirable to drag in either acid to the chrome solution, sulfuric is less harmful than muriatic, as it is already an ingredient of the bath, and would only upset the chrome acid-sulfuric acid ratio.

Packaging of Lime Finishing Compounds

Question: We are experiencing trouble with the deterioration of the card board containers that we market our lime white finishing compounds in. The containers are frequently received in a split condition. Could you advise us as to the possible cause of these difficulties?

G. R. J.

Answer: The trouble you are having is undoubtedly due to the lime in the compound absorbing water from the atmosphere, which causes the compound to swell up and burst the package. A metal container, or a waterproofed paper would overcome this difficulty, or a small amount of some water repellant compound in the composition could be used. The latter is the least desirable method, as it would increase the cleaning difficulties when using the compound on parts to be plated.

Composite Finishing of Die Castings

Question: We are planning to market an ash tray that will be chrome plated around the edge only, with the center portion being bronze colored. What is the best way to do this?

D. M. R.

Answer: A composite finish such as you plan will be very expensive, as it will involve masking, plating, stripping the masking, re-masking for the second plating operation or coloring, stripping a second time, etc. I believe you would be better off using a single plated finish, finishing up with chrome. The center part of the tray could then be colored with a heat resistant paint, if necessary, but this would not be too satisfactory. You might also consider finishing the entire tray in a brown or black color without plating. The names of firms that can supply materials for this type of finish are being sent to you.

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Engineering Information Useful In Designating Metallic Surface Treatments

Engineering Data Sheet

Metal Cleaning

Various methods are in use for cleaning metals prior to electroplating. The following tabulation sums up the important features of each of the most widely used techniques.

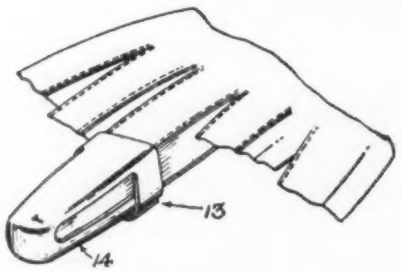
	SOLVENT CLEANING			ALKALINE CLEANING	
	VAPOR DEGREASING	ORGANIC SOLVENTS	EMULSION TYPE SOLVENTS	SOAK CLEANING	ELECTROCLEANING
PURPOSE	Removal of all types of oils, fats, greases, waxes by solution in the solvent. Insoluble particles removed by rinsing action of condensed solvent.	Removal of oils, fats, greases, waxes, etc., by solution in the solvent.	Removal of oils, fats, waxes, and greases by solution and emulsification.	To remove oils, fats, waxes, greases by saponification and emulsification.	Removes oils, fats, greases, waxes, and insoluble and non-saponifiable matter through combination of saponification, emulsification, and mechanical action caused by scrubbing effect of liberated gases.
MATERIALS USED	Trichlorethylene or perchlorethylene.	Many petroleum solvents: kerosene, benzene, naphthas, etc. Most solvents are a blend of various compounds to provide wider solubility characteristics.	Emulsion solvents are mostly kerosene or naphtha bases, with suitable emulsifying agents added to render them miscible with water.	Aqueous solutions of alkalies, including caustic soda and soda ash, borax, silicates, metaphosphates, tri-sodium phosphate and others. Most commercial cleaners are mixtures of above, plus wetting agents and synthetic detergents.	Alkaline cleaning materials listed under soak cleaners. Milder solutions usually used. High conductivity important.
PROCESS	Parts immersed in boiling vapors. Vapors condense on parts and dissolve contaminant, then run off. Special equipment required. Several stages may be used, such as boiling solvent, cold solvent, boiling vapor.	Usually used at room temp., but slight heating is more effective. Parts immersed or sprayed. Agitation of parts helpful. Subsequent alkaline clean necessary.	Usually used at room temperature with agitation. Spraying often used for more thorough cleaning. No special equipment required.	Parts immersed in hot solutions 140-200°F. Spraying also applicable. Rinses freely in water. Strength of solution varies according to metal and degree of contamination, usually from 4-16 oz/gal.	Parts made either anodic or cathodic while immersed in the bath. Cathodic cleaning liberates twice as much gas for scrubbing action, but impurities in the bath may deposit on the work as a smut. Anodic cleaning less effective than cathodic, but impurities do not form films or smut on work surfaces. Overcleaning may cause pitting and etching of alkaline soluble metals.
PROPERTIES	Very effective for all organic materials. Parts are left warm, dry. Will only remove insolubles by rinsing action, but spraying may be used for more effective removal of abrasives, chips, etc. Safe for all metals.	Solvent action not as varied as chlorinated solvents. Depending on evaporation rate, parts may dry off quickly or retain films. No special equipment required, except adequate ventilation. Safe for all metals. Films left on work may contaminate subsequent aqueous baths.	Solvent action similar to straight organic solvents. Blended for greater solvent action. Parts may be rinsed directly in water or aqueous solutions. May be used full strength or diluted with water or kerosene. Safe for all metals.	Requires no special equipment other than a heated tank. Removes insoluble matter (abrasives, chips, etc.) by destroying bond. Not effective with mineral oils or non-saponifiable types of greases and waxes.	Considered as most effective cleaning method available before plating. Combination of cathodic, followed by short anodic clean often used for best results, combining speed with efficiency. Power supply required to give up to 6 volts D.C. at the tank.
NOTES	Solvents are non-inflammable, but toxic. Solvents almost completely recovered in equipment; losses very slight. Fully automatic equipment available for complete process.	Solvents are mostly inflammable, and have low flash points; some fire hazard always present. Certain solvents also toxic. Solvent losses by evaporation and dragout usually quite high, but cost of solvents is about 1/5 that of chlorinated types. Contamination of bath occurs rapidly, necessitating subsequent cleaning step. Reclaiming of solvent practical (with large quantities) by distillation. Provides temporary rust proofing if film remains.	Less contamination for subsequent solutions, due to free rinsing in water. Shortens alkaline cleaning cycle considerably. Provides temporary rust-proofing if not rinsed off. Solvents usually inflammable, and vapors toxic. Low flash points when used straight or diluted with kerosene. Materials not usually reclaimable.	No danger from inflammable solvents. Contamination of the bath requires frequent changing. Materials not recoverable after use. Raw materials cheap, and process meets needs of many small operations.	Provides chemically clean surfaces ready for all plating procedures. Requires power source and heated tank, plus bus bars and anodes. Combination of vapor degreasing followed by electrocleaning considered best all-around cleaning cycle. Safe for all metals, but overcleaning (oxidation, pitting, and etching) on zinc, aluminum, and magnesium alloys must be controlled.

Patents

Protecting Device for Industrial Gloves

U. S. Patent 2,437,886. *Irwin W. Millard and Elmer W. Beatty.*

A reenforcement for an industrial glove comprising a generally T-shaped portion of thin flexible leather having



one entire face thereof coated with permanently tacky adhesive, one portion of the T being adapted to overlie the glove area to be reenforced and adhesively secured to the same with the other portion of the T projecting as an anchorage strip from said one portion and adhesively secured to an adjacent portion of the glove.

Solvent for Degreasing Iron and Aluminum

U. S. Patent 2,436,772. *Walter Klabunde, assignor to E. I. du Pont de Nemours & Company.*

A solvent for degreasing iron and aluminum comprising trichlorethylene containing 0.02 to 1% by weight of an alkyl ester of a nitrogen acid selected from the group consisting of alkyl nitrates containing 2 to 4 carbon atoms and alkyl nitrates containing 3 to 6 carbon atoms, said ester serving to inhibit the condensation reactions of trichlorethylene catalyzed by the aforesaid metals.

Acid Chloride-Fluoride Bath for Nickel Plating

U. S. Patent 2,436,690. *Arthur H. Du Rose, assignor to The Harshaw Chemical Company.*

A nickel plating solution essentially consisting of water from 200 to 400 grams per liter of a source of nickel of the class consisting of (1) nickel chloride and (2) nickel chloride plus nickel sulfate, in proportion such that at least 33⅓% of the nickel is from the chloride, HCl sufficient to produce a pH of from 2.5 to 5, and a source of fluorine of the class consisting of NH_4HF_2, HF, NaF, KHF_2, NiF_2, NiHF and mixtures of a plurality thereof, the total fluorine content of said source of fluorine being equivalent to from 15 to 30 grams per liter of NH_4HF_2.

Coloring Metal Surfaces

U. S. Patent 2,437,441. *Linnaeus Joslyn Rogers, assignor to Associated Chemical Co. Ltd.*

An aqueous solution for use in a bath for coloring copper or copper alloy surfaces consisting essentially of sodium chlorite and a hydroxide selected from the group consisting of sodium hydroxide and potassium hydroxide, and a phosphate salt selected from the group consisting of trisodium phosphate, tripotassium phosphate, sodium tetraphosphate, potassium tetraphosphate, hexametasodium phosphate, hexametapotassium phosphate, pyrophosphates and polyphosphates, the concentration of the hydroxide and sodium chlorite being between: sodium chlorite—5 g./l., hydroxide—10 g./l. to sodium chlorite — saturated solution, hydroxide — 1,000 g./l. and the phosphate salt being present within the range of from about 0.5% to about 3% by weight of the chlorite and hydroxide.

Buffing Machine

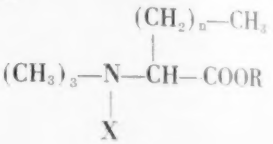
U. S. Patent 2,437,434. *Oliver W. Mojonnier, assignor to Mojonnier Bros. Co.*

A device of the class described comprising a movable main supporting frame, a plurality of rotary elements upon said frame for engaging the work, said elements being mounted for rotation upon parallel axes, means mounted upon said main frame operable to rotate the work resting upon said elements, a pair of fixed vertical posts, vertical supports guided upon said posts, a horizontal support fixed to said vertical supports and having a free projecting end, screw and nut mechanism for raising and lowering said vertical supports and said horizontal support with reference to said posts, a positively driven buffing wheel mounted on the free end of said horizontal support, and means for shifting said main frame toward and from said posts.

Bright Alloy Plating

U. S. Patent 2,436,316. *John C. Lum and George W. Jernstedt, assignor to Westinghouse Electric Corp.*

An alloy electroplating process which comprises electrolyzing an aqueous alkaline cyanide electrolyte containing from 0.01 to 5 ounces per gallon of at least one water soluble, surface active quaternary ammonium compound selected from the group consisting of compounds having the formulae



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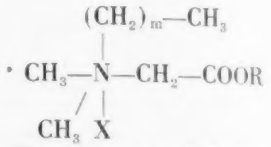
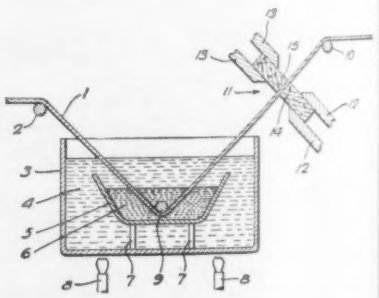


where X represents a halogen atom, R represents an alkali metal, n is a number greater than 11 and m is a number greater than 13, the balance of the electrolyte composed of from 0.5 to 5 ounces per gallon of free cyanide, from 0.2 to 0.5 ounce per gallon of copper, from 0.05 to 0.2 ounce per gallon of tin, from 0.1 to 0.5 ounce per gallon of zinc, anions associated with the copper, tin and zinc, from 2 to 12 ounces per gallon of alkali metal carbonate and from 0.25 to 0.8 ounce per gallon of alkali metal hydroxide, and the remainder being water.

Wiper for Use in Metal Plating Apparatus

U. S. Patent 2,435,766. *Joseph J. Baley, assignor to Western Electric Co., Inc.*

In a tin plating apparatus, a wiper



assembly for removing excess tin from the material being plated comprising a block of asbestos impregnated with

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graphite disposed to effect wiping engagement with a surface being plated, and block engaging members for supporting the block in wiping engagement with a surface being plated.

Production of Active Carbon

U. S. Patent 2,437,174. *Frank Kerr Signai, assignor to E. I. du Pont de Nemours & Co.*

A method for producing highly-absorbent, active carbon in sheeted form comprising impregnating a sheeted, cellulosic material with a solution of a boron compound selected from the group consisting of boric acid and compounds which on ignition yield boric acid until 1-15% by weight of the boron compound is impregnated, igniting the material so impregnated and allowing the same to burn in an excess of air, and then water extracting residual boron compounds from the resulting active carbon product.

Electrodeposition of Silver from a High Silver Cyanide Content Bath

U. S. Patent 2,435,525. *Joseph S. Williams and Walter R. Binai, assignors to P. R. Mallory & Co., Inc.*

The method of making smooth and bright deposits of silver of substantial thickness which comprises electrodepositing the silver from a plating bath containing 90 to 115 grams per liter of silver cyanide, free potassium cyanide of 20% to 150% of the amount of silver cyanide in the bath, potassium carbonate in amounts from a trace to 80 grams per liter, and Potassium hydroxide sufficient to bring the pH between 12.6 and 13.4 using a current density of at least 30 amperes per square foot of the surface area to be plated and maintaining the plating bath at a temperature between 105° and 130° F.

Process for Electrolytically Zinc Plating Magnesium and Magnesium Base Alloys

U. S. Patent 2,437,612. *Hans Osborg.*

A process for providing metallic magnesium and alloys thereof containing at least 51% magnesium with corrosion-resistant surface which comprises establishing an aqueous electrolyte about 1.0 normal to zinc, about 2.1 normal to CN radical, about 0.56 normal to CO_3 radical, about 0.18 normal to fluoride, about 1.45 normal to "free" alkali, and about 2.2 normal to total alkali, pretreating said aqueous electrolyte by electrolyzing said electrolyte using a magnesium test cathode at about 35 to about 400 amperes per square foot at temperatures of about 20° to about 80° C. until about 300 to about 2000 watt hours per square foot of cathode area have passed through said aqueous electrolyte and until said magnesium test cathode is provided with a continuous and adherent coating of electro-deposited zinc whereby a modified aqueous electrolyte is produced, immersing metallic magnesium as cathode in said modified electrolyte, passing an electric current through said aqueous electrolyte at a current density of less than about 40 amperes per square foot at temperatures below 35° C. and voltages exceeding 6 volts until said magnesium is provided with a coating of electrodeposited zinc and zinc-coated magnesium is obtained, and subjecting said zinc-coated magnesium to heat treatment in an inert atmosphere at temperatures above about 600° F. until at least a portion of said zinc coating has diffused into said magnesium and said zinc coating is firmly bonded to said magnesium.

Method of Anodic Cleaning

U. S. Patent 2,437,474. *Gilbert H. Orozco, assignor to Gilron Products Co.*

The method of cleaning and preparing metal articles for plating, which comprises removing carbonaceous film by subjecting the article anodically to a current while immersed in an aqueous alkaline cleaning bath consisting essentially of water as a solvent and a dry solute of ingredients as follows, by weight:

	Parts
A substance selected from the group consisting of sodium acetate and potassium acetate	5 to 50
Sodium hydroxide	10 to 55
Sodium carbonate	10 to 40

and said bath being substantially free from silicates and borates.

Treated Steel Sheet and Process

U. S. Patent 2,438,013. *Robert R. Tanner, assignor to The Patents Corp.*

A ferrous sheet having thereon a plating not over .0001" thick of metal of the group consisting of cadmium, nickel, lead, and copper, and having the plating covered with a thin glassy coating formed by baking thereon a solution containing hexavalent chromium and the PO_4 radical.

Buffing Compound

U. S. Patent 2,436,128. *Robert V. Twyning and William T. Hakken, Jr., assignors to J. C. Miller Company.*

A buffing composition comprising, azelaic acid, solid polyethylene glycol and an abrasive substantially uniformly mixed together.

Bright Alloy Plating

U. S. Patent 2,435,967. *George W. Jernstedt, assignor to Westinghouse Electric Corp.*

An electroplating bath for depositing a bright silvery alloy plate composed of 50% to 75% copper, 15% to 30% tin and 5% to 20% zinc comprising, in combination, an aqueous electrolyte composed of from about 0.5 to 5 oz. of free cyanide per gallon, 0.2 to 0.5 oz. of copper per gallon, 0.05 to 0.2 oz. of tin per gallon, 0.1 to 0.5 oz. of zinc per gallon, alkali metal hydroxide and 2.0 to 12.0 oz. per gallon of an alkali metal carbonate, the electrolyte being maintained at a pH value of from about 11 to 13, and an anti-pitting and brightening agent composed of from 0.01 to 1.0 oz. per gallon of a betaine having at least one non-cyclic hydrocarbon radical which contains from 10 to 20 carbon atoms.

Selenium Rectifiers

U. S. Patent 2,437,995. *Wayne E. Blackburn, assignor to Westinghouse Electric Corp.*

The process of making selenium units which comprises depositing a layer of selenium on a metallic plate, forming a contact layer on the free surface of said selenium, annealing the unit thus formed and thereafter applying a direct-current voltage across the selenium in a direction tending to send current in the high resistance direction while maintaining the temperature of the unit at about 155° C., said voltage having an initial value below the maximum which said unit must stand in the reverse current direction in service, and being gradually raised to a value higher than said maximum.

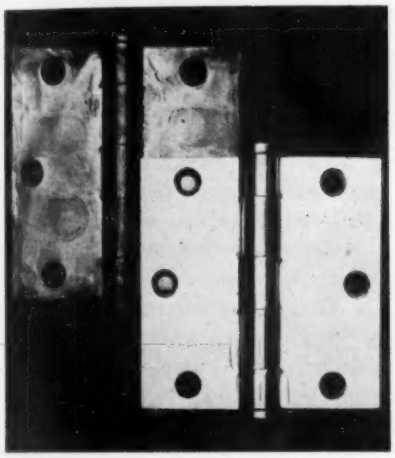
New Methods, Materials and Equipment for the Metal Finishing Industries

Recent Developments

New Acid Agent for Bright Nickel Plating

Enthone, Inc., Dept. MF, New Haven, Conn.

The above firm has announced the development of a new additive called "Actane" for use in acid dips prior to



plating. This material is added to the acid dips used prior to plating, such as hydrochloric or sulphuric acid.

Its function is to disperse and remove colloidal films from the surface of metals that may be deposited during cleaning and which cause the plate to be spotted, streaked, or stained. According to the supplier the results are particularly beneficial for additions to acids for dipping of non-ferrous metals such as copper and brass prior to bright nickel plating.

The photograph illustrates the results obtained in actual production for bright nickel plating upon brass. Prior to use of Actane in the acid dip, the brass hinges came out of the bright nickel streaked as shown. One ounce per gallon of Enthone Actane was added to the acid dip in the cycle and no other changes were made. The plate obtained is illustrated by the specimen on the right. It has been shown that dull plates are frequently caused by colloidal films deposited in alkali cleaners and dull plates obtained are due to these films. In many cases it was believed that the trouble was with the bright nickel bath.

Actane keeps the acid dips used in all plating cycles clearer and makes rinsing of the acid easier. There is no interference with adhesion of any plate applied after using acid dips containing Actane, it is claimed.

Pressure Molded Rack Coatings

Duggan Masking Devices, Dept. MF, 2030 W. Fort St., Detroit 16, Mich.

Some time ago a new type of plating rack was introduced by the above firm. This rack was new in that the coating was pressure molded in heated steel dies. This method eliminates porosity and gives the insulation a very dense structure. In addition, the three hundred ton pressure exerted by the hy-

draulic presses used in molding these racks, bonds the insulation right into the grain structure of the copper conductor bars. This gives an unbreakable bond between the insulation and the metal.

Not satisfied with this departure from standard rack-making procedure, Duggan then applied the same principal to the contacts, or holding clips, on the rack, making them in individual dies and assembling them to the racks as units. This eliminates the usual maintenance work of stripping and dipping or patching replaced work contacts.

These racks are being used extensively in the automotive industry and are ideal for full cycle work because the danger of carry-over of solutions is eliminated by the fact that there is no way in which solution can get beneath the insulation.

Seen above is a picture of the assembly section of the shop where the previously molded racks and contacts are assembled to customer specifications and tested for proper positioning and contact of work pieces.

Buffing and Polishing Machine

Vanott Mach. Corp., Dept. MF. 220 Colgate Ave., Buffalo 20, N. Y.

A new automatic electrically powered buffing and polishing machine capable of finishing 800 parts in one hour is claimed by its makers to have solved the problem of high labor cost in finishing of small objects with diameters up to three inches or up to seven inches if only four spindles are used.

The V-8 Vanott Buffing Machine has eight spindles on a revolving head which indexes at pre-determined speeds. Each spindle is provided with a chuck, or a gripping device, individually designed for each shape, to

hold the work being buffed or polished.

Any firm may secure, without obli-

★ TOP QUALITY

★ FAST CUTTING

★ LONG LASTING

THE SIEFEN COMPANY originated the spray method of applying compound, developed trouble-free spray guns for most economical use of the spray method and is keeping ahead of the field in the manufacture of the finest quality liquid compounds.

Siefen Liquid Compounds cut as fast as bar compounds, are non-settling, clog-free, and fire resistant.

Our engineers throughout the country are at your service to demonstrate how the Siefen Spray Method can cut your buffing costs.

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AND REMEMBER— **NUGLU or BRUSHING NUGLU** (Nuglu and abrasive mixed) are being used for recoating abrasive belts and discs.

J. J. SIEFEN COMPANY

5627 LAUDERDALE - DETROIT 9, MICH.

gation, production and cost estimates from the company's engineering department by simply sending samples of individual products in rough or finished condition.

Hi-Temperature Lucite Plating Tanks

Singleton Company, 9823 *Lorain Avenue, Cleveland, O., Dept. MF.*

Elimination of the final obstacle preventing the use of H-T Lucite for plat-

ing tanks has been achieved by the Singleton-Weld, according to its inventor, Albert Singleton, president of the above firm.

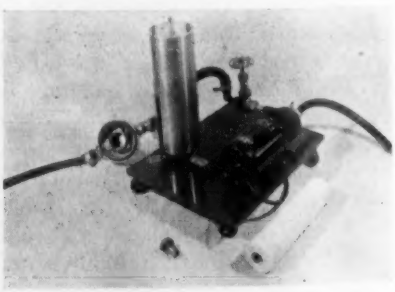
Principal adavantages claimed for these tanks are: resistance to all acids, alkalies; non contaminating, non deteriorating; transparent—11% clearer than glass (for watching baths in action); high impact strength, elastic, shatter-proof, machineable, lightweight and economical; tensile strengths up to 10,00 p.s.i.

Lucite tanks, now in use commercially and in laboratories, have shown no ill-effects after months of continuous exposure to the complete range of plating temperatures and solutions, it is claimed.

Filter Unit for Small Plating Baths

Sethco, 105-07 150*th St., Dept. MF, Jamaica* 4, *L. I., N. Y.*

The above firm has announced the



development of a low-priced filter unit especially adapted to the needs of the small tank operator for either periodic or continuous filtration work. The

unit is constructed of stainless steel throughout, and is suitable for use with all the common plating baths. Because there is only a small volume of liquid contained in the filter, all of which is recoverable, the unit has definite advantages for use with precious metal baths.

The unit is said to be extremely simple and economical to operate. Only 3 minutes are required to set it up, and 20,000-40,000 gallons of solution can be filtered through each filter tube before it needs changing.

The unit comes complete with motor, pump, and filter mounted on a laminated plastic panel. The 110 volt motor operates on either A.C. or D.C., and the entire unit weighs only 30 lbs., making for easy portability.

The filtering tube is made of specially processed cotton yarn wound around a stainless steel core, and requires no filter aids to remove even colloidal particles, according to the manufacturer. Filtration rates as high as 250 gallons per minute are possible, and the rate can be adjusted by means of a stainless steel valve located between the pump and filter.

Tank Heat Transfer Coils

Kold-Hold Manufacturing Company, Dept. MF, Lansing, Mich.

It is now possible to manufacture heated tanks with a completely flat interior surface and without any protruding coils, according to this company. The heart of the new process is the "Platecoil" which has a flat surface on one side and is embossed on the other to form channels for the circulation of the heating agent. This construction eliminates the necessity for internal tubing, reduces the weight per square foot and simplifies installation, it is claimed.

By using Platecoils as the medium of heat transfer, it is possible to build the tank and install the heat transfer plates all in one operation. The flat surfaced plates can be formed and welded as part of the tank bottom, side walls or both. With this flat surface, there is said to be a maximum area for heat transfer which cannot possibly become clogged or coated so as to reduce the efficiency of the plates. For this reason less plate area is required than with conventional designs.

The coils can be furnished in steel with metalized surfaces of various metals, or in Monel, stainless steel or other specified metals. They are avail-

Safe . . . Sure
SKIN PROTECTION
in
Metal Working Plants

Users Prove the Case for MAGNUS SKIN-GARD

MAGNUS Skin-Gard is a soft cream—a dab of which is rubbed into hands and arms and worked around finger nails. It disappears to form a dry, flexible film which protects the hands, arms and nails on the job against abrasions and infections. Yet it is readily washed off at the end of the shift.

Here's ample evidence of its value and practicability, from reports of typical users:

Brass & Copper Tubing	Workers' hands are exposed to a naphtha type solvent in wiping operations on finished tubing. This plant has tried 14 different types of protective creams and found only Skin-Gard to be satisfactory in every way.
Gas Heaters	Protection is needed for workers' hands and skin during painting operations, both against paint and a pre-coating treatment. They have used many kinds of compounds, but since 1942 have standardized on Skin-Gard.
Slide Fasteners	In this plant, dirt, grease and carbon tetrachloride formerly combined with abrasives to cause much lost time due to infections. In 1941, plant-wide comparative tests showed Skin-Gard to be twice as good as the protective cream then being used, and since then it has been regularly used . . . dispensed from the tool rooms.
Metal Fabricating	Much painting is done on the products of this plant—usually on revolving tables. Protection is needed against paint mist on faces and hands. They have used Skin-Gard for five years, after trying most other similar materials.

We'll be glad to send you a liberal sample of Skin-Gard for any kind of comparative test you care to make!

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CLEANERS • EQUIPMENT • METHODS

Presto

BACK STAND IDLER

FEATURES LOW INITIAL COST

AVAILABLE NOW!

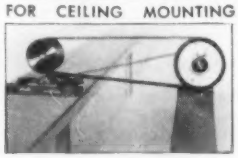
Easily and Quickly Adjusted for various length abrasive belts

Here's real convenience and economy . . . the Presto Back Stand Idler will fit most available space . . . and is adjustable to run close to equipment with a short abrasive belt or to extend to use a standard 168" abrasive belt . . . depending upon your requirements. This adjustment can be made quickly without moving the base.

The Presto Back Stand Idler is of sturdy, all-steel, vibration-free construction . . . equipped with double-sealed precision ball bearings. It can be changed easily from right to left by loosening two set screws and reversing shaft. Adjustable belt tension is maintained by six leaf-type springs. You'll find its initial cost very economical and its performance is "tops". Send today for complete descriptive literature.

PRESTO UNIVERSAL BACK STAND IDLERS ALSO AVAILABLE

FOR CEILING MOUNTING



FOR BENCH MOUNTING

FOR FLOOR MOUNTING

Smooth, Cool-Running Presto Contact Wheels Will Not "Burn" Under Severest Conditions

The Presto Contact Wheel is of outstanding quality that gives fast, smooth, uniform cutting. Made of tough synthetic rubber, the even density of the face of the wheel is uniform throughout . . . for toughest snagging jobs or finest polishing. Available with *soft, medium, hard and extra hard* density.

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BACKSTAND IDLERS • CONTACT WHEELS • TUBE POLISHING MACHINE • SPINNERS • BUFFING WHEEL RAKES • POLISHING WHEEL BUSHINGS • POLISHING LATHE WRENCHES, FLANGES, COLLARS & NUTS • SCREW POINTS • EMERY TROUGHS • BALANCE WEIGHTS & WAYS • TUBE SUPPORT STAND •

• METAL FINISHING SUPPLIES AND EQUIPMENT •

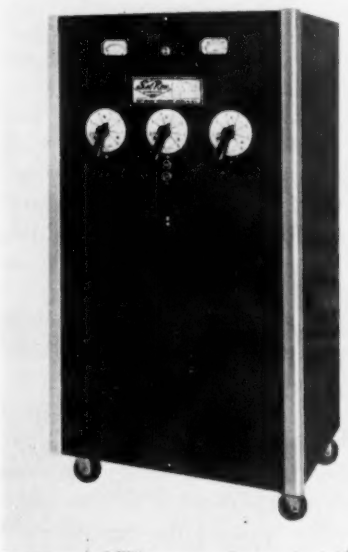
able as plates, in bank form, or fabricated into complete liners where the conditions warrant. Each plate is production tested at 180 pounds per square inch assuring safe operation in extreme conditions.

Additional information is available by writing the Platecoil Div. of the Kold-Hold Manufacturing Company, Dept. MF, Lansing, Mich.

9 Volt-5000 Ampere Rectifier

Bart-Messing Corp., Dept. MF, 45 Morgan Avenue, Brooklyn 6, N. Y.

Engineered and built to fill the need for an economical direct current power source for requirements up to 5,000 amperes with varying voltages from 1 to 9 volts, this unit is suited for chromium, bright nickel and acid copper plating as well as electro-cleaning and electro-polishing.



Full load efficiency is 72%, increasing to 83% at 20% load, according to this firm. Features a continuous plating control which permits changing tap switch positions without plating interruption. Selenium stacks are conservatively rated, with 15,500 square inches of rectifying area and heavily coated for corrosion protection.

Safety elements include positive overload protection in D.C. bus circuit for extra safety; positive protection against ventilation restriction because rectifier will automatically shut off if air intake is blocked; cabinet internally lined with Tygon for protection against corrosion.

The cabinet is mounted on ball bearing casters for mobility and provided with doors for quick accessibility for maintenance.

Mercury Pressure Filters

Mercury Cleaning Systems, Inc., 549 W. Washington Street, Dept. MF, Chicago 6, Ill.

The above firm is offering its new design of multiple plate filter for the pressure filtering of water, oil, chemicals, paint, varnish, fruit juice, wine, syrup, cider, coolants, solvents, and plating solutions. It is rated at 1000 gph. and can be used in multiple for larger capacity.

In design this pressure filter represents a departure from the conventional design. Instead of the multiple handwheel arrangement for clamping the lid, the new Mercury Filter employs a

spring ring clamp which is tested at 120 psi. hydrostatic pressure. This clamp can be removed in an instant and, besides simplifying the opening of the filter for inspection, permits a reduction in the weight of the lid to ten pounds. The clean-out port cover can be removed by a quarter turn of the cover. No wrenches are required.

Filter plates and frames and lining can be furnished to accommodate corrosive liquids and solutions, according to the company.

Full particulars and descriptive literature are available.

Bright Silver Plating

Electro-Met Research Associates, Dept. MF, P. O. Box 634, Cincinnati, Ohio.

A new development of this company is an addition agent for silver plating baths that is claimed to permit mirror bright deposits and decreased plating

for a bright, smooth finish

start with WYANDOTTE

IN THE complete Wyandotte line, there's a product especially adapted to each and every barrel-finishing operation.

Wyandotte Burnishing Compound 317 gives ball-burnished parts of zinc a brilliant finish. Its action is not affected by water hardness. Its cutting qualities help speed the tumbling of steel, brass, copper and zinc with stones. It is free-rinsing and leaves no soap "scum" on the work or in the barrel.

Wyandotte Burnishing Compound 320 gives a highly satisfactory finish to parts of brass, copper, bronze or steel.

Wyandotte Burnishing Compound 321 contains a non-toxic brightening agent which provides ball-burnished parts of steel, copper, brass and nickel with a high luster. It does not require the addition of sodium cyanide.

Wyandotte Burnishing Powder is economical for ball-burnishing or tumbling steel with stones. *Wyandotte 80* (for tumbling steel) and *Light Alloy No. 1* (for zinc and aluminum) have thorough detergent action on light soil, in hard or soft water.

For consistently fine results, at low cost, specify *Wyandotte* Burnishing and Burring Compounds. Your Wyandotte Representative will be glad to give you complete details. He's only a telephone call away.

Wyandotte
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WYANDOTTE CHEMICALS CORPORATION • WYANDOTTE, MICHIGAN
SERVICE REPRESENTATIVES IN 88 CITIES

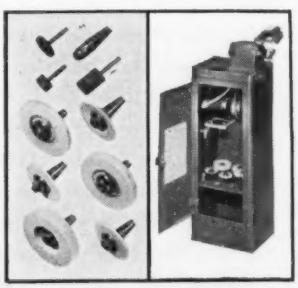
Versatile New Grinder Saves Time —Improves Grinding Efficiency

A new grinder, the Corlett-Turner G-3, permits changing of grinding wheels in a matter of seconds and assures a true running wheel at all times. Each wheel is individually mounted on a ground, tapered arbor.

Easy wheel changing is accomplished by a slight wrist motion on the end bells of the grinder head. A twist to the left releases the wheel arbor; the reverse action instantly secures it in place. It's all done in a matter of seconds. No costly time is lost in repeated wheel dressing.

In addition to its primary function, the G-3 grinder has innumerable uses for burring, buffing, polishing, and production applications requiring a high speed spindle. Powered by a 1/3 horsepower motor, a three-step pulley arrangement provides speeds of 5600, 8000, and 12,000 r.p.m.

Efficiency in precision work is also increased when tension is relieved by the act of chewing. And chewing Wrigley's Spearmint is a pleasant, easy way to help relieve workers' nervous tension. For these reasons Wrigley's Spearmint Chewing Gum is being made available more and more by plant owners everywhere.


Grinding Wheels

Corlett-Turner Grinder

Complete details may be obtained from Corlett-Turner Co., 1001 S. Kostner Avenue Chicago 24, Illinois

AC-66

time thru higher permissable current densities. The firm claims that only 1% of their addition agent is required in a conventional silver bath, and that the brightener is less expensive than similar brighteners for other solutions. Permissable current densities are many times higher than in baths operated without this addition, it is said.

Atlas to Market New Weather-Testing Unit

An announcement has recently been made by the *National Carbon Co.* that the *Atlas Electric Devices Co.*, 361 *W. Sperior St., Chicago,* has taken over the manufacture and sales of the National Weathering Unit Model X1A including repair parts, supplies and service to present users. Atlas is well known in the field as the originator of weathering and fading equipment, and for over twenty-five years has manufactured the Weather-Ometer, Fade-Ometer and Launder-Ometer.

Atlas is now redesigning the Model X1A to incorporate the automatic cycling and other control features of the Atlas Twin-Arc Weather-Ometer but is retaining as a light source the well-known National Sunshine carbon arc. This redesigned weathering unit will be an addition to the regular Atlas line of Weather-Ometers, Fade-Ometers, and Launder-Ometers.

Plating on Magnesium

Dow Chemical Co., Dept. MF, Midland, Mich.

A successful new process for depositing a thin film of zinc on magnesium permits for the first time the electroplating of magnesium by essentially standard techniques, according to recent announcement by *The Dow Chemical Company.*

Electrodeposits of any of the commercially plated metals, such as chromium, silver, gold, copper, brass, cadmium or zinc, now may be applied to any commercial magnesium alloy.

The initial stages in plating magnesium are specifically to remove contamination and provide the correct reactive surface for promoting good adhesion and a continuous deposit. This treatment is followed by a bath which deposits an extremely adherent thin zinc film on the surface of the magnesium. From this point on, all plating is done in commercially used baths and is typical of plating a variety

of finishes on any metal. Actually the same number of steps are involved for plating on magnesium as for plating on other metals.

Excellent adhesion, wear and resistance to accelerated corrosion have been obtained, it is claimed. Parts have been hammered and severely rubbed without lifting the deposit, and the finish has withstood heat, humidity and salt spray tests satisfactorily. While preliminary exterior tests have indicated satisfactory corrosion resistance, it is recomended that exterior uses involving severe exposures be given tests under actual use conditions until additional exterior test results are available.

Applications for which the new plating process is expected to be used include automotive and building hardware; optical equipment, such as cameras and binoculars; and sporting goods. On these the decorative qualities of the finish are considered especially advantageous.

Magnesium engraving plates are being chrome plated experimentally and are being found to exhibit increased wear resistance. Other commercial uses involving wear resistance are showing outstanding preliminary results, it is claimed.

The plating process is commercially available under license granted by The Dow Chemical Company.

Stop-Off for Selective Tin Plating

Acheson Colloids Corp., Dept. MF, Port Huron, Mich.

By combining their research facilities with those of a large manufacturer of tin plated bearings, the above firm has developed a coating material that performs ideally as a "stop-off" for selective hot dip tin plating.

The coating is easily applied to that portion of a surface where it is found desirable or necessary to prevent the adhesion of the tin.

It will readily withstand a muriatic acid pickling bath used in tin plating operations as well as the fluxing dip and molten tin dip, according to this company.

Heavy Duty Plastic Coatings

Glover Coating Co., 376 Washington St., Dept. MF, Malden 48, Mass.

This firm is equipped to process tanks, baskets, racks, pails drums, fans and a large number of other articles

Bring Your
CLEANING PROBLEMS
to the DETREX
CONSULTATION
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BOOTH 67-68
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Atlantic City • June 28-July 1

For technical advice on preparation of work for plating and other finishing processes—for the latest information on metal cleaning—visit Booth 67-68 at the Industrial Finishing Exposition. Detrex engineers and laboratory technicians will be on hand, prepared to assist you.

These Detrex men are specialists in every phase of metal cleaning. They'll be glad to help you out of any difficulties you may have—and they'll tip you off to the latest methods of getting more thorough cleaning with greater speed and economy.

In addition, at the Detrex booth you'll see

- ★ **Perchlorethylene Parts Dryer** at work—efficiently removing all moisture from finished parts.
- ★ **Metal Parts Spray Washer** in operation—one of many Detrex machines designed for the plating and finishing industries.
- ★ **Solvent Vapor Degreasing**
- ★ **Alkali and Emulsion Cleaners and Strippers**
- ★ **Spray Booth Coatings and Water Conditioners**

Make the Detrex Consultation Booth your Exposition headquarters for technical help and information. And remember—if you can't attend the Exposition, the Detrex man in your territory will provide the same free consultation service.

DETREX Corporation
DETROIT 32, MICHIGAN

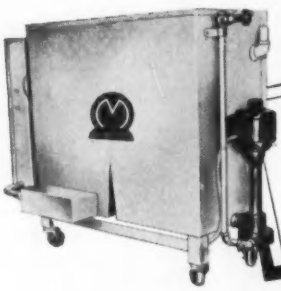
Announcing... the joining of

MIDWESTERN MFG. CO., INC.

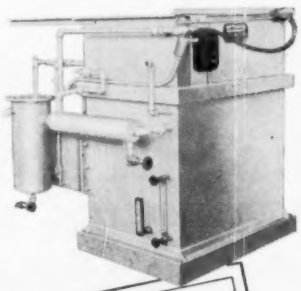
with the

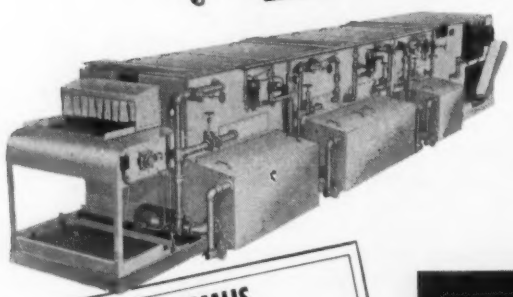
OPTIMUS EQUIPMENT COMPANY

The MIDWESTERN line of Vapor Degreasers and Degreasing Solvents will be continued supplementing the present line of Optimus products.



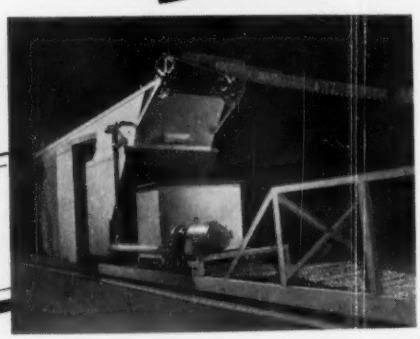
MIDWESTERN Portable Vapor Degreaser





OPTIMUS Vapor Spray Degreaser

OPTIMUS Multi-Stage Spray Washing Machine



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Standard and Special Types of equipment from the smallest to the largest sizes for a wide variety of metal degreasing, washing, cleaning, rinsing, pickling, drying and allied process operations.

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OPTIMUS EQUIPMENT

FOR CLEANING · RINSING · DEGREASING · PICKLING AND DRYING OF METAL PARTS

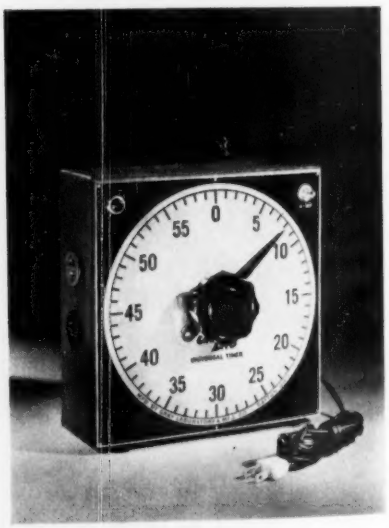
with various corrosion resistant coatings such as rubber, synthetic rubber, vinyl plastics, phenolics, and many others.

Also produced by this company is a special corrosion resistant paint for use in corrosive atmospheres, such as on the outside of tanks and fume exhaust hoods. This paint is claimed to be very resistant to all strong acids and alkalis, and comes in two colors, black and gray. Will withstand temperatures up to 160°F., and can be applied either by brush or spraying. No special preparation is required for excellent adhesion to all metallic surfaces, it is said.

Electroplating Timer

Gray Laboratory & Mfg. Co., 43 W. Apple St., Dept. MF, Dayton 2, Ohio.

A universal electric timer for use in timing batch operations such as electroplating has been developed by the above firm. Having a range of 1 minute to 60 minutes, the instrument is ruggedly built for plant service, and has a large, easily read 8 inch dial of stainless steel, with black numerals. The hand and shaft are also made of



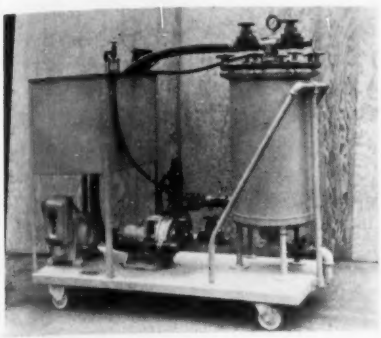
stainless steel to resist corrosive fumes.

There are two outlet receptacles: one for use in turning an appliance ON at the end of a pre-selected time; the other for turning the appliance ON at the beginning and OFF at the ending of the pre-selected time interval. The sturdy steel case, equipped for either table or wall mounting, is finished in a black wrinkle finish.

Complete Industrial Filtering Units

Co-Operative Industries, Inc., 100 *Oakdale Rd., Dept. MF, Chester, N. J.*

A complete filtration unit for industrial uses is offered by the above firm. These units are available in sizes to meet every need, and in various corrosion resistant materials for use with all types of solutions. Designed for use with filter aids, the unit utilizes two types of retainers; stone and carbon, which are cleaned by "back washing" after filtration is completed. No dis-assembly is required for cleaning this type of filter.



The units comprise a stainless steel pump, motor, valves, pre-coat tank, and filter chamber mounted on a truck base for ease of portability. Sizes up to 2500 gals. per hour are standard.

Emulsion Cleaner

Apothecaries Hall Company, Dept. MF, Waterbury 88, Connecticut.

Ahcoloid Emulsion Cleaner is a new development in emulsion cleaners to replace hydrocarbon and chlorinated solvents. It can be safely used on all metals and is especially desirable for cleaning buffed zinc base die castings or aluminum parts which would be stained by prolonged immersion in alkali cleaners. Ahcoloid Emulsion Cleaner has special surface active agents which impart to it a high degree of emulsifiability, wetting and penetrating action, and rapid rinsability, it is claimed. It is classed as a safety solvent with a flash point of 100 degrees F. Operation is at room temperature. Ordinary steel tanks are used to hold the cleaner.

Sanding Disc Backing Pad

Pratt Mfg. Co., Dept MF, 614 E. Madison St., Fairmont, Ind.

A new Spiralcool backing pad for disc sanders is being produced by

START WITH A GOOD FINISH

PLATERS—Does your plate peel because of improperly cleaned work?

Are you having trouble cleaning pierced, grooved and filigreed surfaces after buffing and polishing?

TRY—PURICO WONDERBAR

A Pre-Saponified Tripoli protected by patents.

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THE PURITAN HANDBOOK

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THE PURITAN MFG. CO.

WATERBURY 85, CONN.

Now You Can Have Highest Test Pure Water for Plating at only 5¢ per 1000 gallons!

NEW BARNSTEAD

UPFLO Demineralizers

Have 3 Important Advantages

1 New Efficiency Lowers Cost per Gallon
The combination of improved synthetic resins and the UPFLO method of operation result in much higher purity and at the same time lower operating costs. Depending on the amount of minerals to be removed from the raw water this may well be as low as 5¢ per 1000 gallons.

2 Regenerating Time Cut Nearly in Half
Another advantage of UPFLO operation is that "backwashing" is entirely eliminated. This important saving in labor represents a considerable reduction in operating costs and further reduces the cost of the water.

3 Package Unit — Easy to Install
Barnstead UPFLO Demineralizers come completely assembled with all inter-connecting piping, gang-operated valves, and built-in regenerating tanks. They are compact, efficient units, ruggedly constructed with handsome stainless steel cabinets and console type control panels. They need only be connected to raw water supply and waste to start operating. Ready for immediate delivery. Send for Bulletin 117 and prices.

FIRST IN PURE WATER SINCE 1878

235 Lanesville Terrace — Barnstead STILL & STERILIZER CO. Inc. — Forest Hills, Boston 31, Mass

the above firm. The new backing pad is made of layers of rubber reinforced with fabric and securely bonded to a slotted iron hub. The solts in the hub forces air through to the back of the sanding disc, keeping it cool under most severe usage, it is claimed. The forced draft action through the spirals on the pad tends to keep the abrasives clean, giving them much longer life. The pads, being made of rubber, allow greater flexibility in working various shapes and contours without the danger of gouging the work and provides greater contact area of the disc, according to the manufacturer. The forced draft action minimizes the loading up of the abrasive disc thereby reducing costs materially in both labor and material.

Single Dip Rack Coating

Michigan Chrome & Chemical Co., Dept. MF, 6351 E. Jefferson Ave., Detroit 7, Mich.

A new improved single-dip heat-cured rack coating, to be known as Miccrosol E-1003, has been introduced by the above firm.

This material is a new 100% solids heat-cured rack coating that produces a tough, smooth, leather-like coating with a single application; is superior (by actual test analysis) to other similar coatings known to the plating industry, it is claimed.

A series of tests on tensile strength, adhesion, hardness, tear strength, elongation, and recovery show a marked superiority over other well known rack coatings. It combines, in addition to positive insulation and protection: permanent flexibility, positive and continuous adhesion, great scuff resistance, simplicity of application, savings in time, labor, and material, according to the manufacturer. It withstands all commonly used plating solutions, acids, and caustics — is nonporous and has high dielectric strength.

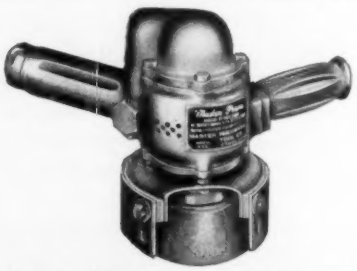
Only one coat is required over the primer. The extreme and lasting adhesion of the prime coat, which is also impervious to acids and caustics, completely eliminates contamination due to carry-over from capillary action. Racks are completely processed, ready for use, in approximately 2 to 4 hours, it is claimed.

Pneumatic Vertical Hand Grinder

Master Pneumatic Tool Co., Inc., Dept. MF, Orwell, Ohio.

The above firm has recently put on the market a new addition to their line of portable pneumatic tools.

A new light weight vertical type grinder, sander and wire brushing tool,



called the Master Model M-401, is now available in speeds of 6000 RPM and 8000 RPM free speed. It performs a variety of metal removing jobs in foundries and other metal finishing plants.

A few of the new features embodied in this tool are as follows: Weighs only 7 lbs. because of magnesium housings and better design; Positive governor control assures safety with positive "off and on" throttle control: Small overal dimensions permits working in close corners and limited space: Economy of power—uses less air to deliver more power.

Electronic Temperature Controller

Thomas A. Edison, Inc., Instrument Div., Dept. MF, West Orange, N. J.

A temperature controller, said to be simple, fast, and precise, has been developed by the above firm. The device uses a single electronic tube with an

electrical resistance type bulb for thermal pick-up, and is of the on-off type.

The use of the resistance bulb permits location of the sensing element at a point remote from the control panel and eliminates the necessity of thermal compensation. This device, which is non-indicating, may be used to control temperatures to close tolerances in solids, gases, or liquids. Units are available to cover the temperature range from —100°F to 1200°F and are adjustable within a range of several hundred degrees.

Supply voltage may be 115 or 230 volts 50-60 cycle alternating current. Load capacity is 30 amperes at 115 volts, 20 amperes at 230 volts. Accuracy of the controller is independent of usual voltage variation, it is claimed. Normal response time is under three seconds, due to the patented bulb construction.

A 5" x 5" x 10" control panel, weighing less than 8 lb., complete, is furnished and is provided with conduit knockouts and a rugged terminal board. This may be located at any convenient place and at considerable distance from the temperature zone.

Converting Grinder to Backstand Sander

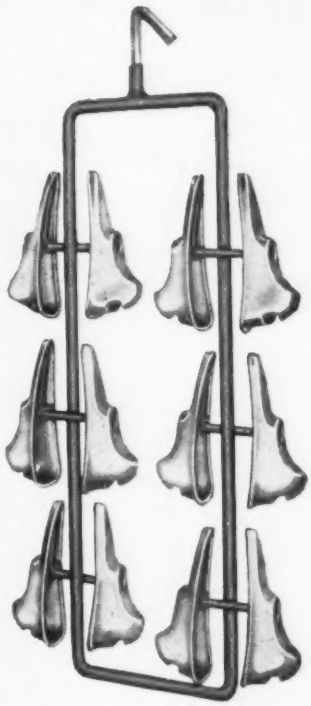
Aget-Detroit Co., Main and Washington Sts., Ann Arbor, Mich. Dept. MF.

Standard pedestal grinder is quickly changed over to dustless backstand sander-grinder combination by means of standard backstand attachment, dust collector, a new type hood and two lengths of flexible metal hose.

The changeover from standard two wheel grinder to combined "dust-proofed" grinder-backstand sander requires no duct work, no cutting of wall or ceiling for ducts since the dust collector is entirely self-contained having motor driven fan, cyclone separator, and second stage filter for recirculation of cleaned air back to the working area to save heat.

The right hand grinder wheel and its hood are removed, a standard backstand attachment and a hood of special shape are substituted—the hood being fastened in position on the tray of the pedestal grinder. A three inch diameter sleeve projecting from the back of the hood permits a slip fit connection with standard flexible metal hose. The dust outlet of the other wheel hood is likewise connected up with the flexible metal hose and both are then fastened to the double inlet of the dust collector, which is said to be capable of providing ample suction for a continuous two-man grinding and sanding operation. Plugging in of the electrical motor cord completes the installation.

BUNATOL



No. 1000

INSULATION

For racks and fixtures used in electro plating, anodizing, electro polishing, phosphate coating and electro forming.

SAVES LABOR

Has extra fluidity. Dips freely. Handles fast, without delays or trouble. A rack can be completely insulated in two hours.

SAVES TIME

No evaporation — no shrinkage — no loss. Short oven bake converts to continuous solid coating that has no effect on, but excellent resistance to all plating solutions and cleaners.

SAVES MONEY

Racks last longer because a single dip gives an extra heavy, thick, extremely tough, long life protective coating, which far outwears ordinary types of insulation—and at less cost.

APPLICATORS:

If you prefer to send your racks out for insulating write for name and address of nearest applicator using No. 1000 Insulation. That means you get the best at the right price.

100% Solids

No liquid to evaporate. Does not become thick or lumpy. Always ready to use. Not inflammable.

Write for details and prices

NELSON J. QUINN COMPANY

TOLEDO 7, OHIO

Temperature Controller and Indicator

Thermo Electric Manufacturing Co., 480 W. Locust St., Dept. MF, Dubuque, Iowa.

A new stepless input controller and temperature indicator has been developed by the engineering department of this company to fill the needs for an inexpensive instrument that will provide both variable control and indication of temperature.

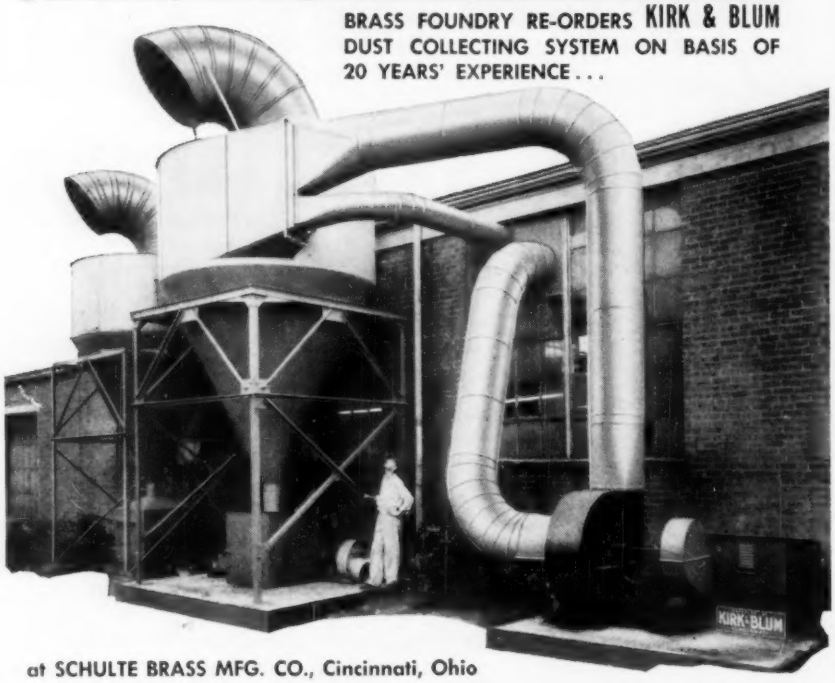
The instrument contains a dependable pyrometer calibrated in both Fahrenheit and Centigrade scales to 2000° F. and 1100° C. A 4 foot color-coded thermocouple of 14 gauge chromel-alumel is supplied. The instrument panel also houses a toggle switch and neon pilot light.

The complete unit is attractively styled in a welded steel case with gray wrinkle finish. Size is 9" wide, 5" high and 8" deep, and the weight is 6 lbs. Rubber feet and a metal bracket are both supplied for either desk or wall mounting.

Eight models of the instruments are

Greater power savings justify higher initial cost..

BRASS FOUNDRY RE-ORDERS KIRK & BLUM DUST COLLECTING SYSTEM ON BASIS OF 20 YEARS' EXPERIENCE...



at SCHULTE BRASS MFG. CO., Cincinnati, Ohio

Buying on a competitive bids system, this manufacturer of cast brass bathroom accessories and fixtures checked every feature of proposed dust collecting systems. After rechecking and consideration of the notable 20-year service record of an existing Kirk & Blum Polishing and Buffing Dust Collecting System, *Kirk & Blum* was *selected again.*

The new system, cyclones for which are shown above, proved again that efficient design by Kirk & Blum Engineers gave power savings that more than offset higher initial cost, even over a short period of time.

Whether you have more than twenty Kirk & Blum Systems (as a number of our customers do) or have never owned one, Kirk & Blum Engineers are ready to give expert advice concerning the efficient handling of air. Write for Bulletin V, "Fan Systems for Various Industries" or Bulletin M, "Dust Collecting Systems for Metal Industries."

FOR CLEAN AIR... THE INVISIBLE TOOL

KIRK AND BLUM

DUST CONTROL SYSTEMS

THE KIRK & BLUM MFG. CO.
2859 Spring Grove Ave.
Cincinnati 25, Ohio

available, covering current requirements of 115 and 230 volts, 10 to 35 amperes, 25 and 50/60 cycles AC, and for DC. Additional information and descriptive literature may be obtained by writing to the manufacturer.

Disc Cement

The Kindt-Collins Company, 12563 *Elmwood Ave., Cleveland, Ohio, Dept. MF.*

Originally noted for its time-and-labor-saving efficiency in the changing of abrasive discs, Master Disc Cement once again is guaranteed to produce absolutely satisfactory results in the cementing of light, flexible or cloth-backed abrasives.

Master Disc Cement is easily applied to both the abrasive and the metal disc with a bristle brush. When the cement changes color, the abrasive disc is placed in position and rolled smoothly so that complete contact is made, it is claimed. The brush can be cleaned with water.

Business Items

Mutual Chemical to Build New Plant

Mutual Chemical Company of America, according to a statement issued by its president, *George Benington*, has completed plans for the construction of a new Bichromate plant on property adjoining the company's present plant in Baltimore. The new facilities are scheduled for completion by the end of 1949 and will include additional capacity which, together with the company's existing facilities, should be sufficient to satisfy all likely demands and also provide improved working conditions and more efficient operations.

Fifty-Six New 25-Year Employees Honored by Manhattan Rubber

Fifty-six new 25-year employees of the *Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J.*, were honored recently at the Fourth Annual Dinner of the organization. The dinner, attended by nearly 600 persons, also honored those entering new five-year groups. *John F. D. Rohrbach*, newly elected president of Raybestos-Manhattan, Inc., was the principal speaker.

H VW-M Promotes Bauer and Norton

John A. Bauer, former Sales Manager of the *Hanson-Van Winkle-Munning Co.*, has been appointed Vice President and Sales Manager to succeed *Louis M. Hague*, newly appointed President of the company. Mr. Bauer has been with the company twenty-two years starting as Advertising Manager of the former A. P. Munning Co. He later served as Manager of the Pittsburgh, Philadelphia and New York offices, returning to the home office in 1939 as Assistant Sales Manager.

John A. Bauer

Robert M. Norton

Robert M. Norton has been appointed Assistant Sales Manager. Prior to his new assignment, Mr. Norton was engaged in sales promotion activities at Matawan; before that, he served H-VW-M customers in the electroplating and polishing equipment and supply field in the capacity of District Manager for New York and New England and Field Representative in the New York State territory. Before joining the H-VW-M organization in 1940, he was a district sales manager for the Western Union Telegraph Company.

Mathieson Chemical Corp. Appoints New Research Administrator

Dr. D. P. Morgan has joined the *Mathieson Chemical Corporation*, formerly *The Mathieson Alkali Works*, as Administrator of Research and Development, *Thomas S. Nichols*, Mathieson president has announced. Dr. Morgan will be in charge of market research as well as chemical research and development. For the past two years he has been with W. R. Grace and Company in New York in charge of chemical market research and development.

Dr. Morgan was graduated from Harvard University in 1916 and received a Ph.D. in chemistry from Columbia University in 1923. He was a partner in the firm of Loomis, Stump and Banks, consulting chemical engineers, for four years before joining Scudder, Stevens and Clark as chemical consultant. For the last several years of the war he served as Director of the Chemicals Bureau of the War Production Board.

A fellow of the American Institute of Chemists, Dr. Morgan is also a member of many other organizations, including the American Chemical Society, the American Institute of Chemical Engineers, and Sigma XI, honorary scientific society.

New Plant of Cowles Detergent Co.

The Cowles Detergent Company, Cleveland, O., announces the completion of a new million dollar plant at Skaneateles Falls, New York. One of the most modern chemical plants in the country, it is equipped with up-to-date technological equipment for the manufacture, packaging and shipping of the Cowles line of heavy chemical detergent silicates as well as the company's line of specialized detergents for the commercial laundry, metal cleaning, food sanitation and other fields.

The company's plants at Lockport, New York, and Sewaren, New Jersey, are operating at capacity. The addition of the new plant at Skaneateles Falls, where operations have already commenced, makes it possible for the company to expand production to the point where deliveries can be effected more promptly and in increased quantities. It also enables Cowles to expand

A New Horizon for Metal Finishing
BLACK MAGIC
FOR FLEXIBILITY
FOR RESISTANCE TO HEAT
FOR NO DIMENSIONAL BUILD-UP
FOR DURABILITY & ATTRACTIVE APPEARANCE
FOR A CORRECT OPTICAL BLACK
1
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4
5
Lift your product out of the "everyday" class by using BLACK MAGIC single-bath oxide black!
1. Black Magic, a rich, permanent black finish, is extremely flexible and can be applied to springs and similar wire products. It will not chip or flake off but becomes an integral part of the metal surface.
2. High resistance to heat is vital in spark plug finishes. Black Magic, a tough, heat resistant and rust inhibiting finish, is used regularly where heat changes are frequent and extreme.
3. As a protective finish for gears and small parts, where tolerances are important, Black Magic covers completely, yet effects no dimensional change.
4. Durable, attractive in appearance, Black Magic's smart black adds greatly to sales appeal and service life of radio parts. The deep-penetrating, single-bath oxide is economical, easy to use.
5. For exacting specification work in optics, Black Magic is a consistent performer. After subsequent processing, Black Magic makes possible the non-reflective, optical black required in optical instruments.
Write for the "Black Book" of details on Black Magic for iron and steel, copper and its alloys, zinc and cadmium.
MITCHELL-BRADFORD CHEMICAL COMPANY
MODERN METAL FINISHES
2446 C MAIN ST., (Stratford) BRIDGEPORT, CONN.
CHICAGO OFFICE: 111 W. Jackson Blvd.
BLACK-MAGIC OXIDE BLACKING SALTS
WITCH-DIP & WITCH-OIL FINAL FINISHES
SILCO Glass-Base PROTECTIVE COATING
HEAT TREATING SALTS. CLEANERS. ETC.

Reduce your overhead ... effectively control fumes

Niehaus Fume Separator

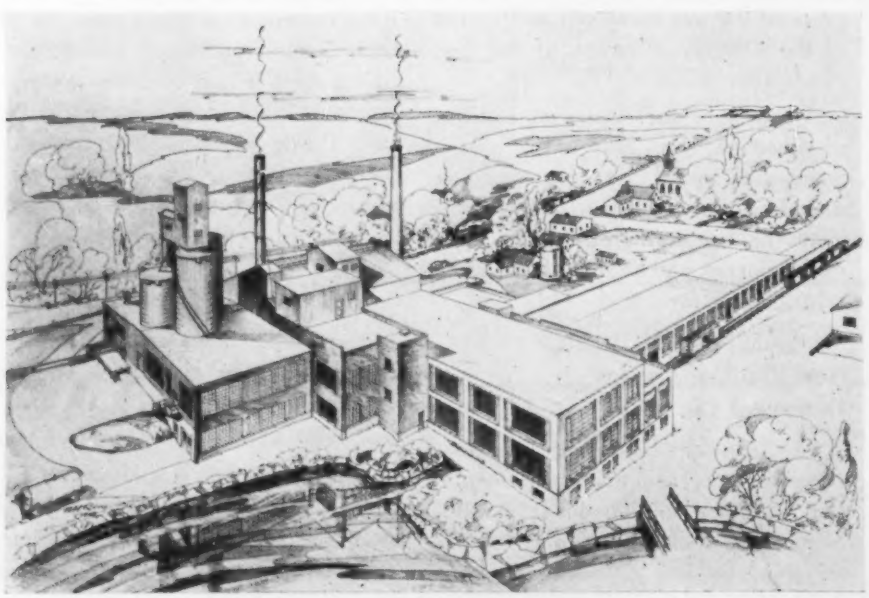
● Niehaus Fume Separators will reduce your overhead two ways . . . overhead expenses and space-consuming overhead ductwork. By water absorption and centrifugal separation, it will effectively control the fumes from your cleaning and plating solutions.

The complete unit is located alongside your tank . . . no expensive blowers or long ducts are required. No air is discharged outside.

For complete specifications and information on how the Niehaus Fume Separator eliminates costly equipment, reduces installation costs, and sells for less. Write for illustrated folder.

See a Niehaus Fume Separator in operation in Booth 11 at the A.E.S. Exposition in Atlantic City, June 28 to July 3. The new Niehaus Dust Control Unit also will be shown for the first time.

INDUSTRIAL ELECTROPLATING COMPANY, INC.
219 West Vermont Street, Indianapolis 4, Indiana



New plant of Cowles Detergent Co.

sales in the industries now served as well as reach new markets not previously touched. Completion of the new plant is indicative of this company's determination to improve constantly it's products and the services it renders customers in all fields.

Herr Becomes Vice-Pres. of National Rack Co.

Mr. E. L. Faulman, President of *National Rack Co.*, announces the appointment of *Mr. J. F. Herr* as Vice

J. F. Herr

President. Mr. Herr contributes to National Rack Co. twelve years of diversified experience in the field of metal finishing. Prior to joining National Rack, he was Eastern Division Manager for Standard Plating Rack Co. During the war period, Mr. Herr was with Chrysler Corp., in charge of all metal finishing at the Dodge Chicago plant. Previously he was associated with Wright Aero Corp., of Paterson, N. J., manufacturers of aircraft engines.

New Representative Named by Pennsalt

Appointment of *William D. Wilson* as district sales representative in Northern New Jersey and New York City for the Special Chemicals Division of the *Pennsylvania Salt Manufacturing Co.*, was announced by *Joseph J. Duffy, Jr.*, Manager of Sales.

Wilson, before joining Pennsalt last January, was a chemist with the McCormick Rubber Company, Ridgefield Park, N. J., for 11 years and with Curtis-Wright, Caldwell, N. J., for six years. Mr. Wilson, a graduate of Pratt Institute, Brooklyn, N. Y., is a member of the American Electroplaters'

Society. He and Mrs. Wilson and their two children reside at 31 Byrd Avenue, Bloomfield, N. J.

Van Gray to Represent American Buff Co.

Van M. Gray has recently been appointed St. Louis, Southern Illinois and Minneapolis sales-representative of the *American Buff Company, Chicago, Ill.* Mr. Gray brings to his new position a solid background of business

Van M. Gray

experience over a period of 17 years. During eight of these years he was a successful sales executive.

A Philadelphian by birth, Mr. Gray spent his college years at Georgia Tech. He now lives in Chicago with his family.

Mr. Gray will handle the complete line of American Buffs and Polishing Wheels, rendering a full sales-engineering service.

Wyandotte Regional Supervisors Meet

Wyandotte Chemicals Regional Supervisors recently held a week's conference at the home office. Plans were made for the seven sales meetings now being held for the more than 200 representatives of the J. B. Ford Division of the Wyandotte organization.

One of the highlights of the conference was a plant trip to several new manufacturing units which comprise the $25,000,000 Expansion Program of Wyandotte Chemicals Corporation.

Mr. Robinson's keynote to the Wyandotte organization was to sell by giving better service to customers. During the round table conferences he intro-

CHROMIC ACID

99.75% PURE

With two complete, independent plants at Jersey City and Baltimore, and over a hundred years of technical background, Mutual is the world's foremost manufacturer of Chromic Acid.

MUTUAL CHEMICAL CO. NEW YORK

OVER A CENTURY OF CHROMIUM CHEMICAL PROGRESS

Bichromate of Soda

Bichromate of Potash

MUTUAL CHEMICAL COMPANY OF AMERICA

270 MADISON AVENUE NEW YORK 16, N.Y.

Wyandotte regional supervisors.

SEE THE
BUCKINGHAM PRODUCTS Company
LINE OF
POLISHING and BUFFING COMPOSITIONS
BOOTH 179 and 180
INDUSTRIAL FINISHING EXPOSITION

• • The increasing popularity of Buckingham Products Polishing and Buffing Compositions indicate that more and more metal finishers are becoming aware of the many advantages these products offer.

3517

THE BUCKINGHAM PRODUCTS COMPANY
14100 FULLERTON AVE. • DETROIT 27, MICH.

duced speakers from the following departments of the Wyandotte organization—Research, Credit, Development, Patent, Market Research, Advertising, Technical Service, Food & Beverage, Package, Industrial, Laundry and Textile, and Maintenance Cleaning.

Minnesota Mining Appoints Two Vice-Presidents

J. C. Duke was elected vice-president in charge of the Coated Abrasives Division, and *J. A. Borden* was elected vice-president of the Scotch Tape Division of the *Minnesota Mining and Mfg. Co., St. Paul, Minn.*, in April

Mr. Duke joined the firm in 1921 and has been Sales Manager for Sur-

J. C. Duke

J. A. Borden

face-Coated Abrasives. Mr. Borden has been with the firm since 1925, the last seven years in charge of sales of Scotch tapes.

Metalcraft Moves to New Quarters

Metalcraft Engineering Co. has moved to its new and larger quarters located at 230 *Verona Avenue, Newark 4, N. J.*, and has installed the equipment and materials for metal finishing by mass tumbling.

They are also the exclusive distributors for 8 states in the East for Honite, Super Honite and Compounds, as manufactured by the Minnesota Mining & Manufacturing Company and also for Almco tumbling equipment as manufactured by the Almco Division of Queen Stove Works of Albert Lea, Minnesota.

Our New Editor

On October 15th, 1947 *Mr. Walter A. Raymond* joined the staff of *Metal Finishing* as Engineering Editor. Mr. Raymond brings to *Metal Finishing* a wealth of experience in the field, having spent 15 years as a chemist, metallurgist, process and materials engineer, teacher, and supervisor of finishing in several of the largest metal fabrication plants in the East. A member of the Electrochemical Society, American Electroplaters Society, The Electrodepositors Technical Society, American Society for Metals, and The American Society for Testing Materials, Mr. Raymond received his education at Brooklyn Polytechnic Institute and New York University. He is well informed on the various aspects in the field of electroplating and finishing

Walter A. Raymond

from both the practical and theoretical angles, and is constantly in touch with the latest developments in the industry.

In addition to his editorial duties, Mr. Raymond will continue to assist readers with their finishing problems through the Shop Problem section, which is a regular monthly feature of *Metal Finishing*.

G. S. Rogers Appoints Representatives

G. S. Rogers and Company, Chicago processing materials firm, has appointed Lubrication, Inc., of Rochester, N. Y., as central and western New York distributors of their products which are used in the heat treatment and finishing of metals. *T. Richard Young* will head the newly-created processing materials division of Lubrication, Inc., with headquarters in Rochester, New York, and representation in the central and western New York area.

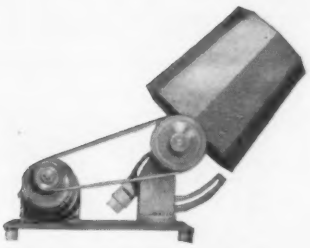
Ambrose McNamara, with offices at 11 West 42nd Street, New York, has been appointed eastern New York and New England states area representative.

Mr. McNamara is well known in the New York industrial and manufacturing field, being experienced in metallurgical and production processing problems, and having been associated with manufacturers of materials and products used in heat treatment and finishing of metals.

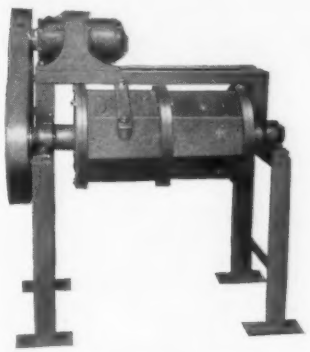
Mr. McNamara will have complete charge in the eastern New York and New England states area of all sales, servicing and application of G-S-R specification products.

ON SMALL JOB LOTS

FINISHING COSTS TUMBLE



TILT-TYPE BENCH MODEL — motor or belt driven. Adjustable elevation. Steel, wood, rubber lined or alloy metal barrels.



HORIZONTAL FLOOR MODEL — light duty for bulk tumbling and burnishing of small parts.

. . . . when you use a Henderson Oblique Tilt-type Bench Model Tumbling Barrel.

Ideal for SMALL-LOT FINISHING and SAMPLE LOT PRODUCTION of jewelry, clock parts and similar products requiring a *quality finish at minimum cost.* Widely used in laboratory experimental work.

ALSO HORIZONTAL TUMBLING BARRELS — both light and heavy duty for small-lot and quantity production.

Tumbling barrels for every purpose or, made to order to meet your special requirements.

Write now for further information.

Since 1880 Designers and Builders of Tumbling Barrel Equipment.

THE HENDERSON BROS. COMPANY
135 SOUTH LEONARD ST. WATERBURY 85, CONN.

Union Carbide Elects Dr. Curme as Chemical Research Vice-Pres.

The election of *Dr. George O. Curme, Jr.*, as Vice-President—Chemical Research of *Union Carbide and Carbon Corporation* is announced by Fred H. Haggerson, President. Dr. Curme has been for many years a Vice-President and Director of Bakelite Corporation, and Carbide and Carbon Chemicals Corporation, both large and important Units of Union Carbide.

Dr. Curme is a pioneer in the American organic chemical industry. His research work on acetylene at the Mellon Institute of Industrial Research, Pittsburgh, from 1914 to 1919, resulted in the formation in 1920, of Carbide and Carbon Chemicals Corporation.

Dr. Curme has been the recipient of

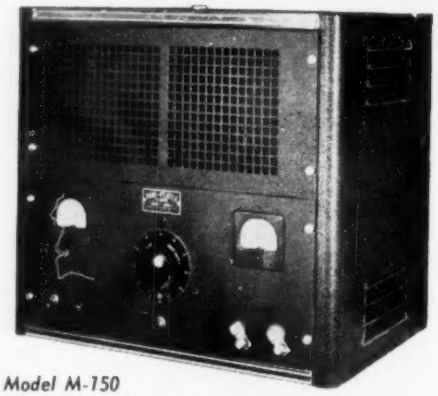
Dr. George O. Curme

FOR BETTER PLATING . . . AT LOWER COST

It's the **VARI-PLATER***
PACKAGED INDUSTRIAL RECTIFIERS

★ VERSATILE
★ VARIABLE DC VOLTAGE
★ INSTANTANEOUS DC POWER
★ EXTREMELY COMPACT
★ STURDILY CONSTRUCTED
★ SIMPLE TO INSTALL
★ ECONOMICAL TO OPERATE
★ EASY TO MAINTAIN
★ FULLY GUARANTEED

For laboratory and production work Lewis Electric offers a complete line of portable packaged industrial rectifiers ranging in output from 8 volts 25 amps to 8/16 volts 500/250 amps, and in size from 10½" x 21" x 15" deep to 42⅞" x 22" x 18" deep.



Model M-150
0-8 volts—150 amps
Model MD-150
0-8/16 volts—150/75 amps

* REG. TRADE MARK

FOR MORE INFORMATION WRITE TODAY FOR YOUR FREE COPY OF "LEWIS RECTIFIERS FOR ELECTRO-PLATING."

FOR PLATING

- GOLD
- SILVER
- CHROMIUM
- NICKEL
- BLACK NICKEL
- COPPER
- CADMIUM
- BRASS
- BRONZE
- COBALT
- IRON
- LEAD
- PALLADIUM
- RHODIUM
- TIN
- ZINC
- ALLOYS
- *On Metals and Non-Metals.*

Model K-25
0-8 volts—25 amps
Model K-50
0-8 volts—50 amps

LEWIS ELECTRICAL MANUFACTURING COMPANY
1943 WALTON AVENUE, NEW YORK 53, N. Y.

many medals in recognition of his achievements in chemistry. He received the Chandler Medal from Columbia University in 1933, the Perkin Medal, awarded by the Society of the Chemical Industry in 1935; the Elliott Cresson Medal from Franklin Institute in 1936; the National Modern Pioneer Award from the National Association of Manufacturers in 1940; and the Willard Gibbs Medal from the American Chemical Society in 1944.

He attended Northwestern University, took a year of graduate study at Harvard University, and a doctorate at the University of Chicago. He then went abroad to study with Fritz Haber, discoverer of the synthetic ammonia process at the Kaiser Wilhelm Institute. He also studied with Emil Fischer, a co-discoverer of the Fischer-Tropsch synthetic chemical process at the University of Berlin. At the outbreak of World War I, Dr. Curme returned to the U. S. to begin his work at Mellon Institute.

Beacon Wiper Supply Co. Changes Name

The Beacon Wiper Supply Co., of 110 *Marginal St., Chelsea, Mass.*, has announced a change in name to the *Beacon Supply Co.* The firm manufactures buffs for the metal finishing industry.

Udy Receives ACS Award

The Jury of Award of the Western New York Section of the *American Chemical Society* has awarded the Jacob F. Schoellkopf Medal for 1948 to *Marvin J. Udy*, internationally known chemist and metallurgist. Among Udy's better known achievements is the development of the process for cadmium plating, the patents for which formed the basis for the formation of the *Udylite Corporation of Detroit.*

Thomas Steel Co. Appoints E. J. Roehl

Appointment of *Edward J. Roehl* as manager of technical development at The Thomas Steel Company was announced by company officials.

For the past 11 years Roehl has engaged in research and development work with the International Nickel Co. and was an officer and active member of Monmouth County Section of the American Chemical Society. In addition he was active in committee work with American Society for Testing Materials and a member of American Chemical Society, Electrochemical Society, Electrodepositors' Technical Society and American Electroplating Society. He is the author of a number of technical papers on electroplating and has been a speaker before a number of local section meetings.

In 1942 Roehl was joint recipient with W. A. Wesley of the American Electroplating Society prize. He received his BS degree in chemistry in 1928 and his MS degree in chemistry in 1929, both from Cornell University. He majored in physical chemistry under W. D. Bancroft with thesis work in electrochemistry. He undertook additional graduate work at Columbia University, some research work at New York University and performed physical-chemical research in the chemical field before starting metal finishing, electroplating and corrosion work with the International Nickel Company in 1937.

Roehl is married and has two children. His family will move to Warren in June and will reside at 1727 Tod Avenue NW.

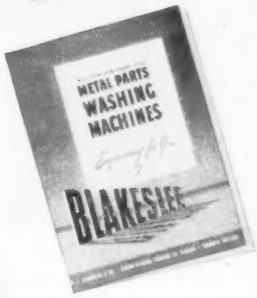
New Firm to Produce Plating Racks

Mr. J. F. Reed, Jr. announces the opening of a new company to be known as *The J. F. Reed Manufacturing Corp.*, which will specialize in the design and manufacture of plating and heat treating racks and accessory equipment. A new plant has been purchased and is already in operation at 286 *Hamilton Street in New Haven, Conn.*

Purchasers of equipment of this type are undoubtedly familiar with Mr. Reed and his pioneering efforts in

the design and production of cost-cutting racks and equipment engineered for specific plating and heat treating jobs. Until the first of the year, he was President and General Manager of Reed Company, Inc., which in turn was an outgrowth of Enthone-Reed. He no longer is connected with the above mentioned companies in any way, the business which he is now conducting in his new and modern plant being an entirely new and separate organization.

The plant is thoroughly equipped and staffed for the design and production of specialized plating racks, heat treating racks and holders.



Write today for FREE booklet on Blakeslee Metal Parts Washers to answer your particular cleaning problems.

Whether the finishing operation is enameling, lacquering, machining, plating or inspecting, your washer must do a perfect cleaning job. The Blakeslee Metal Parts Washer is especially adaptable for cleaning between operations and prior to inspection . . . Continuous and batch type metal parts washers are familiar equipment throughout the automobile and aviation industries, as well as all other metal fabrication fields.

G. S. BLAKESLEE & CO.

BLACOSOLV DEGREASERS AND SOLVENT

NIAGARA METAL PARTS WASHERS

G. S. BLAKESLEE CO., CHICAGO 50, ILLINOIS
NEW YORK, N. Y. TORONTO, ONT.

Midwestern Manufacturing Company Joins with Optimus Equipment Company

Optimus Equipment Company, Matawan, N. J., manufacturers of metal parts vapor degreasers, washing and drying equipment, announces the joining of that company and the *Midwestern Manufacturing Co., of New York, N. Y.*, manufacturers of vapor degreasers.

The Midwestern line of vapor degreasers and degreasing solvents will be continued supplementing the present line of Optimus products. The company will continue under the name, Optimus Equipment Company, with headquarters and manufacturing at Matawan.

The officers of the new company are: *V. W. Todd*, chairman of board, *M. Jaffa*, president, *A. T. Baldwin*, vice-president, *E. N. Close*, secretary and treasurer.

Schreiber to Represent Schneible in Chicago

The *Claude B. Schneible Co.*, 2827 *Twenty-Fifth Street, Detroit, Mich.*, manufacturers of dust and fume collection and disposal equipment, announces that *George C. Schreiber* of their Sales Engineering Department has been placed in charge of the Northern Illinois and Wisconsin territories with headquarters at 1809 *W. North Avenue, Chicago.*

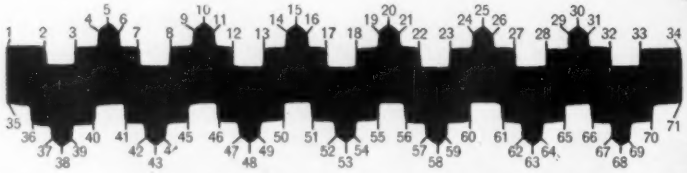
Mr. Schreiber acquired a fine background through functioning in various capacities at the Schneible plant and through contact with users of dust control equipment over the years.

Brown Instrument Announces $2,500,000 Expansion Plan

A $2,500,000 expansion program,

how DIVCO Self-Scrubbing Action Increases Chrome Plating Efficiency

71 throwing edges on Divco Anodes produce violent agitation with self-scrubbing action that sweeps surfaces clean and eliminates stagnation — Just count the 71 throwing edges.



Improved Chrome Plating Quality— *FASTER* with Reduced Cost

You can see the increased turbulence that demonstrates fast plating action the minute you put Divco 71-Point Lead Anodes to work. Pound for Pound they cost no more than ordinary anodes. Equip a tank and compare results.

***AVOID SUBSTITUTES*—Look for "Divco" beneath the hook or count the 71 edges. Order from your jobber or direct.**

"A Good Name Carries Weight"
Division Lead Co.
828 W. Kinzie St. Chicago 22, Ill.

Other DIVCO PRODUCTS
LEAD
Antimonial — Chemical — Tellurium
in Pipe — Sheet — Foil
or Fabricated for All
Plating Shop Requirements

Walter Webb

announced by *Brown Instrument Company, Philadelphia,* will add more than 60 per cent to its present manufacturing space and a proportionate increase in employment, said *Henry F. Dever,* president.

The program includes construction of a four-story addition to the main plant at Wayne Junction. The new building will add 95,000 square feet to existing main plant space. The addition will comprise five floors, including a basement of about 19,000 square feet per floor.

Brown Instrument is is a wholly owned subsidiary of the *Minneapolis-Honeywell Regulator Co.,* and operates as the industrial division of the parent firm. The Brown company was established in 1859 by *Edward Brown* and incorporated in 1910 by his son, *Richard P. Brown* who today is serving as chairman of the board. In addition, he is a director and vice president of Minneapolis-Honeywell.

U. S. Stoneware Appoints Phila. Representative

Howard Farkas, vice president and general sales manager of the *U. S. Stoneware Company, Akron, Ohio,* has announced the appointment of *Walter Webb* of Philadelphia as sales representative for the Philadelphia area.

Mr. Webb took over his new position April 12. Before his association with U. S. Stoneware, he was general superintendent of Ralph V. Rulon, Inc., Philadelphia. Mr. Webb has had many years experience as a sales engineer in the chemical and maintenance fields for industry. He has had wide experience in the corrosion-resistant field and is an expert in acid resistant flooring construction, tank linings and protective coatings. His experience also covers construction and installation of acid and caustic waste disposal systems and chemical reclaiming systems. As a designer, estimator and supervisor in corrosion-resistant material construction and installation, Mr. Webb has many developments for the usage of various corrosion-resistant materials to his credit.

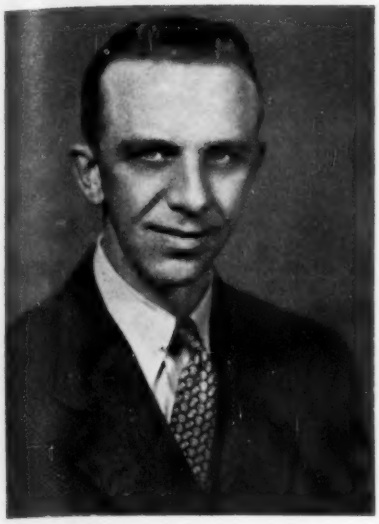
During World War II Mr. Webb served two years with the U. S. Navy as a member of a ship repair unit. He is a graduate of the Mechanical Engineering School of Drexel Institute, Philadelphia.

R. W. Helmig Elected Vice President and Director

The Electric Products Company, Cleveland, O., manufacturers of battery-charging equipment, electrolytic equipment, synchronous motors and other specialty equipment, announces the election of *R. W. Helmig* as a Vice President and Director at the Annual Board of Directors' Meeting.

R. W. Helmig joined The Electric Products Company in December, 1944. Previously, he has been connected with Delco Products Corporation, Commercial Investment Company, W. W. Sly Manufacturing Company and had owned The Planefilm Corporation.

The election of R. W. Helmig to the Board of Directors reflects The Electric Products Company policy of selecting executive personnel from men



R. W. Helmig

active in production and manufacturing methods to keep pace with the accelerated demands of the Industrial Market.

Pennsalt Transfers Special Chemicals Salesman

John M. Davidson has been named Pittsburgh district sales representative for the *Special Chemicals Division* of the *Pennsylvania Salt Manufacturing Co.*, it was announced by *Joseph J. Duffy, Jr.*, Manager of Sales. Davidson formerly was sales representative in the Northern New Jersey and New York City territory.

Mr. Davidson fills the post formerly held by *William J. Hennessy*, now Pittsburgh District Sales Manager of the Special Chemicals Division.

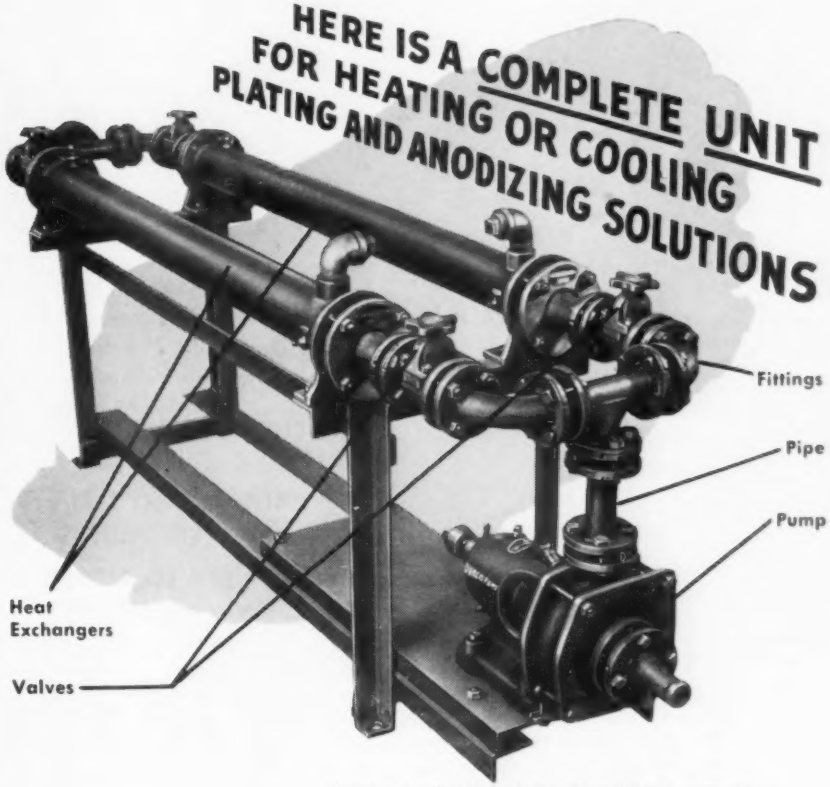
Mr. Davidson graduated from Dickinson College with a bachelor of arts degree and earned a degree of master of education at Temple University. Prior to joining Pennsalt in July, 1946, he taught at high schools in Clayton, N. J., and New York Military Academy, and was a salesman for the Ediphone Company, Philadelphia.

Thomas J. Donnelly

We announce with deepest regret the passing of *Mr. Thomas J. Donnelly*, President and founder of the *Eastern Felt Co.*, of Winchester, Mass., on March 25th.

Mr. Donnelly was well known in the finishing field, and his many friends and associates will mourn his untimely death.

HERE IS A COMPLETE UNIT FOR HEATING OR COOLING PLATING AND ANODIZING SOLUTIONS



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CORROSION RESISTING ALLOYS & EQUIPMENT

Specially designed for handling corrosives, this standard unit consists of two heat exchangers with the necessary valves, pipe, fittings and pump — all made of the well-known alloy, Duriron.

Duriron is a high-silicon iron with extreme resistance to corrosion from bright nickel and chrome plating solutions, anodizing solutions and many other corrosives.

Similar units are available with one to nine or more heat exchangers in banks, supported by one frame.

Prints showing typical layouts will be sent on request. Ask for Folder T.

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Branch Offices in Principal Cities

DURCO Adv. 49-GM

NEW BOOKS

Journal of the Electrochemical Society, No. 3, Vol. 93

Published by the *Electrochemical Society*, 235 *W.* 102 *St., N. Y. C.*, Price $1.00 to non-members.

Besides the news on the activities of the society, this journal contains the following technical papers:

Passivity of Chromium by N. Hackerman and D. I. Marshall

Chromated Protein Films for Metal Protection by A. Brenner, G. Riddel and R. Seegmiller

Corrosion Inhibition by Nitrite by R. Pyke and M. Cohen

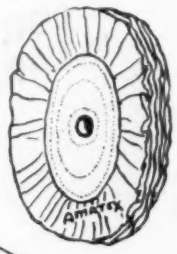
Electrolytic Thickness Tester by H. T. Francis

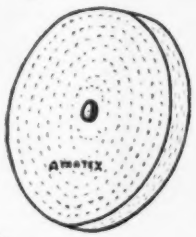
Electrochemistry of Indium by B. S. Hopkins and T. Moeller

Forming of Austenitic Stainless Steels

This book was compiled to give fabricators of metal equipment a better understanding of the adaptability of stainless steels to all modern processes of forming. This book presents a detailed description of the modern forming procedures as applied to chromium-nickel stainless steels and as practiced in the fabrication plants of the United

Look to AMATEX For Your BUFFS!





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SPIRALLY SEWED FULL DISC BUFFS
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CRESCENT BUFFS
SEWED PIECED BUFFS
JEWELERS SHELLACKED HARDENED CENTER BUFFS

ONLY NEW SHEETING IS USED IN THE MANUFACTURE OF AMATEX BUFFS!

Type	Count	Weight
Sunlite	64-64	3.15
Arrow	80-80	4.00
Mercury	80-92	3.50
Harvest	48-48	2.85
Fortress	69-74	2.85
Viking	86-93	2.60

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PROMPT, EFFICIENT SERVICE

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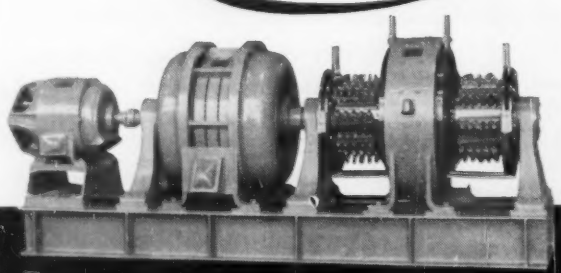
Motor Generators by COLUMBIA



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Electroplating — Anodizing
Electrocleaning — Electropolishing

There's a Columbia M-G Set available for your needs, whether you have a small plating bath or a large continuous strip plating line. Capacities up to 20,000 Amperes; 6 Volts and up. Dependable, performance proved, for many years. Your inquiries solicited.

Write today for Catalog MF-700

COLUMBIA ELECTRIC MFG. CO.
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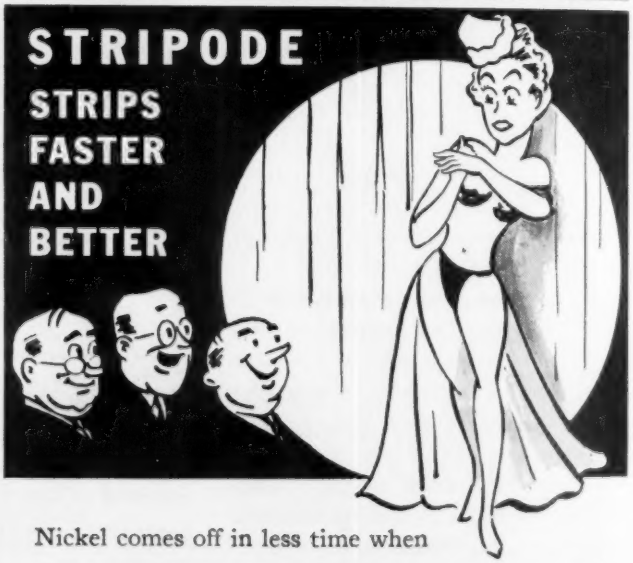
STRIPODE STRIPS FASTER AND BETTER



Nickel comes off in less time when you add STRIPODE to your regular Sulphuric Acid baths. STRIPODE cuts acid consumption . . . protects the base metal . . . prevents pitting and roughening . . . often eliminates the need for polishing and buffing. Order a gallon today. Try it. You'll like it.

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BOOTH NO. 164

FINISHING SHOW
ATLANTIC CITY
JUNE 28—JULY 1

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- CUT LABOR COSTS
- SAVE TIME!

Produce semi-lustrous finish on stampings, machined parts, die castings, forgings, extrusions for automotive, building, plumbing, appliance, general hardware, fishing tackle, tools, business machines.

Roto-Finish speeds finishing operations. Eliminates hand labor. Produces surface uniform on all pieces. De-burrs as well as finishes.

Send parts for sample processing!

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419 Jacob Street
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States. Bending and straight flanging; forming of curved sections and tubing; deep drawing; die forming; forming of contoured-flanged parts, and forming by miscellaneous methods are some of the methods discussed in the book. The specific examples of forming technique are supplemented by details of tool design and tool materials, lubricants, data on dimensions, and consecutive steps in fabrication.

This book is available from International Nickel Co., and copies may be obtained in the United States by mailing checks of $4.00 for each copy to *The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.*, and in Canada by addressing *The International Nickel Company of Canada, Limited, 25 King Street West, Toronto 1, Ontario.*

Annual Proceedings of the American Electroplaters' Society

American Electroplaters Society, Box 168, Jenkintown, Pa. Price $10.00.

The complete series of technical papers, including the discussions, that were presented at the 34th Annual Convention held in Detroit in June 1947 are now available in book form. Topics covered are Physical Properties of Electrodeposits, Stresses in Electrodeposits, Electroforming, Protective Power of Plated Metals, Testing Methods, Barrel Chrome Plating, Bright Brass Plating, Purification Methods, Effect of Surface Finish on the Protective Value of Deposits, and many others by outstanding representatives in the field. The volume also includes the record of activities of the Society for the year and a list of Branches and their officers.

TIPS ON VENTILATION FOR SMALL SOLVENT USERS

The operator or manager of the small plant or shop and the occasional user of solvents frequently need to be reminded that good ventilation is essential whenever and wherever solvents are used. Unless operations such as degreasing, thinning, cleaning, etc., are provided with adequate ventilation, workers may inhale sufficient quantities of solvent vapors to cause illness.

For occasional solvent operations, it is best to do the job outdoors on a breezy day, whenever possible. When the work must be done indoors, it should be carried out in an airy room

TITEFLEX Filter Model 5A 1000 showing porous membrane.

One of the many economies of the **Titeflex** *Filter*

CLEANING of the TITEFLEX Industrial Filter requires only 7 to 20 minutes, depending upon the size of filter and type of solution being filtered. A new method of backwashing simplifies the entire cleaning process, eliminates waste labor, and completely removes all residue.

Other important savings made possible by the TITEFLEX Filter are:

1. LOW MATERIAL COST—a few cents worth of filter aid serves for each batch filtered. No expensive filter pads or asbestos sheets.
2. LOW LABOR COST—a completely sealed system requiring a minimum of labor.
3. LARGE CAPACITY—3 to 10 times that of the other equipment with equal filtration area.
4. NO LEAKAGE—therefore no loss in expensive filtered material.

If you are looking for a highly efficient filter that will give you sharp, clear filtration at the lowest possible cost, then investigate the TITEFLEX filter. Write for descriptive folder—today.

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Exclusive Manufacturers of Titeflex high quality products for more than 30 years

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Tough jobs *have* been made easy with DANIELS Heavy Duty Compositions.

Years of experience in manufacturing compounds have led to the development of the present popular line of DANIELS Buffing Compounds; quality and performance are kept at a peak through rigid control and hy-grade materials.

For special requirements, special materials can be made.

Write or telephone for further information or a sample.

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Electroplating and Polishing Equipment and Supplies

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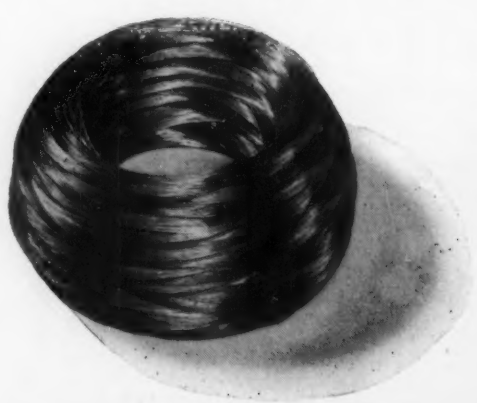

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Copper Wire

Bare copper wire in coils or spools in all gauges for plating use. Prompt shipment. Catalog No. 60 on request.

Flexo Wire Company
70 W. FIRST STREET OSWEGO, N. Y.

near an open window. If adequate natural ventilation is not available occasional small solvent jobs may be done safely by protecting workers with canister gas masks. Of course, the mask protects only the worker who wears it, and care must be taken that other workers in the room are not exposed to solvent vapors. For large jobs which are done only at intervals, a portable blower may be the most practical method of providing protection.

Where solvents are used constantly or frequently, it is usually necessary to provide special ventilating equipment. The equipment may be designed to ventilate the entire workroom. In this case, attention should be given to the area immediately around the solvent operation. For example, a man using solvent to wipe machine parts may be inhaling too much vapor, even if the air in the rest of the room is safe.

Often it is best to use equipment which ventilates locally, that is, which removes the solvent vapor at the point it is released, before it spreads through the workroom. Thus, a ventilated booth, an exhaust hood over the workbench, or a work table with ventilator slots around its edge, can protect the operator and also prevent contamination of the air in the rest of the workroom.

Large continuous solvent operations require the use of fully or partly enclosed equipment from which solvent vapor cannot escape. Even the small plant or shop may find such an installation worth while for an important solvent operation.

The operator of a small plant can obtain assistance on ventilating problems from the industrial hygiene service of his local health or labor department.

News from California

By Fred A. Herr

International Rectifier Appoints Southern California Representative

Eric Lidow, of International Rectifier Corporation, manufacturers of selenium rectifiers, announces the appointment of *E. V. Roberts & Associates* as their representative for Southern California.

Ernie Roberts has been engaged in

E. V. Roberts

the sales engineering field for the past eleven years except for a tour of duty with the Royal Air Force during the early period of the war and then as a 1st lieutenant with the U. S. Marine Corps.

Roberts' duties with the RAF were conducted under the title of Assistant Superintendent of Radio Maintenance where he planned and supervised all radio, radar, and IFF installations for the RAF Ferry Command at Montreal. As a lieutenant in the U. S. Marine Corps he was assigned to the electronics division of the Bureau of Ships as a radar and IFF design engineer. Upon the termination of hostilities Mr. Roberts returned to his firm whose office is now located at 5014 *Venice Blvd., Los Angeles* 35, *Calif.*

Harry Rorick, advertising manager for *Turco Products, Inc., Los Angeles*, was the principal speaker at the May 20 meeting of the Industrial Advertising Association of Southern California in the University Club, Los Angeles. Speaking on the subject, "*Coordination of Industrial Advertising With Sales*," Rorick described how the Turco Co., which manufacturers some 300 items for leading industries throughout the nation, including many for the metal finishing business, reaches top industry heads through advertising and sales promotion.

Latex Dipped Products Co. completed construction and outfitting of a new plant at 4194 *Pacific Way, Los Angeles*, and have moved office and manufacturing facilities.

The new plant is a 54 x 68 foot one-story all-steel structure with double the

BRILLIANT LUSTROUS DEPOSITS WITHOUT COLOR BUFFING ... AN IDEAL BASE FOR CHROMIUM

NEW IMPROVED

Lustrebright

Bright Nickel Process

Produces Brilliant, Lustrous, Adherent Nickel Deposits • Eliminates Color Buffing — Re-Cleaning — Re-Racking • An Ideal Base for Chromium • Excellent Throwing Power • No Special Solutions or Changes in Equipment Required • Easy to Control • Low in Cost • Successful • Practical.

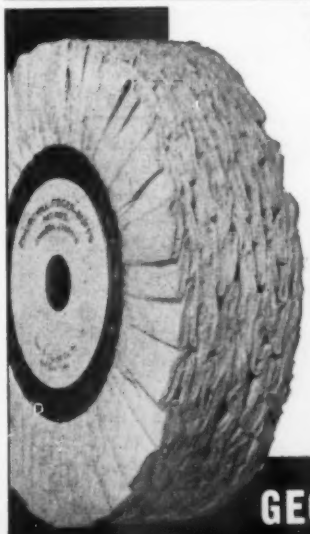
Gives uniform results and continuous operation on all classes of work in still tanks and mechanical barrels. Substantially reduces plating costs. Brilliant, lustrous, nickel deposits that may be chromium plated, are produced by merely adding NEW IMPROVED LUSTREBRIGHT to your present cold or lukewarm nickel solution.

Work comes from plating tanks with bright, fine grained, adherent deposits. No color buffing or burnishing is required. Work may be transferred direct from nickel to chromium bath, without intermediary buffing, re-cleaning, or re-racking. Excellent for zinc die-castings.

GUARANTEED NOT TO HARM PLATING SOLUTION. Will not cause plate to peel, become brittle, or produce streaky deposits. Illustration shows unbuffed deposits produced before and after addition of NEW IMPROVED LUSTREBRIGHT. Write for complete information.

W. C. BRATE COMPANY

14 MARKET ST. *Est. 1860* ALBANY, NEW YORK



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CHURCHILL FINGER-BUFFS

— AIR COOLED —

Faster Cutting — Lower Costs

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NO. QUINCY 71, MASS.

Under U. S. Patents Nos. 2146284, 2350216. Others Pending.

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SPEEDIE TRIPOLI

—Quality Buffing Compositions for a Superb Job on Brass, Bronze, Aluminum and Die Castings

Whether you demand a composition for a production line, or an all-around material for job work, there is a *SPEEDIE* Tripoli for your plant . . . proved over and over on all types of brass, bronze, aluminum stampings and die castings.

If you are looking for a high grade, saponifiable tripoli, we suggest No. 431 *Speedie* Tripoli Composition which is unbeatable for those hard-to-buff jobs. Unusually successful for plumbers' brass and brass automobile bodies. Here's a real chance to save on your cleaning. Write today for prices and samples.

But whatever type of buffing you do, remember there's always available a *Speedie* Composition —Stainless Steel, Chrome, Nickel, Satin Finish, Emery Cake, Plastic or Grease Stick. Feel free to call on us at any time. There's no obligation.

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Drop by our Booths 119 and 120 and say hello! Our "Sel-Rex Story" is an "eye opener" and we want you to see it.

BART-MESSING CORPORATION

(Manufacturers of Sel-Rex Selenium Rectifiers)

45 Morgan Avenue Brooklyn 6, N. Y.

amount of floor space of the old factory at 4620 East Washington Blvd. It is designed with a 26 foot ceiling to permit the handling and turning of large size tanks during lining operations. Building and equipment are reported to represent an investment of $20,000 to $25,000.

The firm is operated by *John Mergell* and his son William, John serving as president, and Bill as plant superintendent. The firm produces tank linings, and also does acid protecting dip work for racks, tanks, buckets, measures, pitchers, dip baskets, and other items for the plating trades.

Pre-organizational activity aimed at the formation of the Southern California Section of the *Electro-Chemical Society* was underway in Los Angeles in May.

Edward Calderon, head of the Electro-Chemical Engineering Laboratory of Los Angeles, one of the prime movers in the project, reported that some 25 representatives of the electro-chemical and allied fields had indicated their intention of attending a meeting at the Case Hotel, Los Angeles, to organize their efforts to get this section started.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Los Angeles Branch

Richard Crane, vice-president of the *Lea Mfg. Co., Waterbury, Conn.*, was the principle speaker at the May 12 meeting of Los Angeles Branch. Mr. Crane presented a talk on finishing methods in vogue today, with special emphasis on the polishing phases of operations and the preparatory work that precedes polishing and buffing.

The speaker discoursed at some length on the subject of polishing wheels and the proper ways of using them. Among developments now becoming increasingly popular, he mentioned roto blasting or vapor blasting, and flexible polishing, this latter now being done without greasing. Mr. Crane also touched upon spray buffing, an operation which he cited as one of the most advanced developments in the industry. The procedure is practical, he said, and will continue to grow in usage under a technique that permits the compound to be delivered to the

buffing wheel in emulsion form by spraying.

A film produced by the Lea Mfg. Co. was shown. It featured proper methods of securing the material to the buffing wheel by black sizing.

The new 1948-49 officers, which were elected at the April meeting, were installed at the business session by Earl Coffin, who has handled that job so often and well, that it has become traditional to find Earl explaining to the incoming officers what duties they have to perform.

Heading the group of new officers was *Frank Bunker*, sales engineer of the L. H. Butcher Co., who signalled his induction as new president by appointing *Gil Bishop* as sergeant-at-arms. The dispatch and skill with which Mr. Bunker entered upon his new duties indicated that the splendid leadership with which *Howard Woodward* of the Sundmark Supply Co. carried the branch during the past year will continue under Mr. Bunker's administration.

Retiring President Woodward was presented with the past-president's button, and a parting gift in the form of a pen and pencil set. *John W. Dunn* of the E. B. Dunn Co., was initiated into membership.

Upon recommendation of a special committee, the branch voted to become one of the 15 charter members of the *Technical Societies of Southern California.* This is an organization recently established for the purpose of affording technical socities in general an opportunity to make their influence in their area felt more effectively through joint action. Eventually, the new organization hopes to solve the meeting-place problem, which affects all technical societies in Los Angeles, more or less, by arranging for a conveniently located building, designed and equipped for meetings of various technical groups.

New England Regional Conference

The ninth Annual New England Regional Conference was held at the Hotel Taft in New Haven on May 1st. The Conference was sponsored by the various branches of the A.E.S. throughout the New England states, and attracted over 1000 members and guests.

Speakers at the technical session were:

Prof. Samuel Glasstone of Boston Col-

THE BIAS BUFF

Featuring

TYPE "K"

A POPULAR buff from the well known BIAS Line, typifying certain points of excellence —characteristic of all BIAS Buff & Wheel Company products—and an assurance of higher buff efficiency and greater economy in all classes of buffing work.

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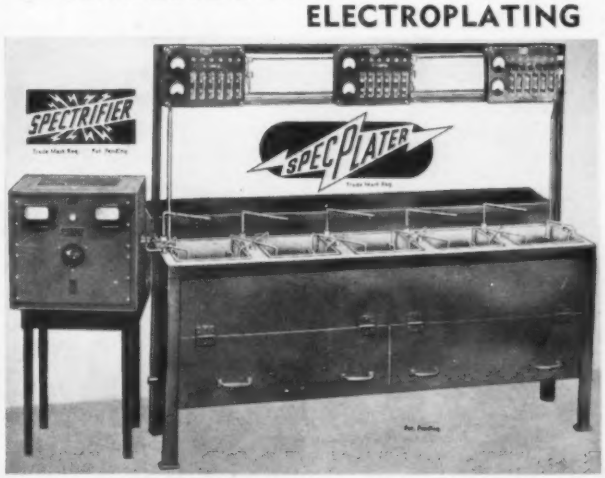
A COMPLETE STANDARD COMPACT ELECTROPLATING 5 TANK UNIT



'SPECPLATER'

- Rinsing unit attached in rear with removable overflow outlet for drain.
- Rheostat frame attached with rheostats.
- Gas burners attached with individual cocks.
- Stainless Steel tanks or enamel lined tanks.
- Anode and cathode connections streamlined.
- Bus bar connections scientifically arranged under the table.

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CONTACT WHEELS

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INDUSTRIAL FINISHING
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JUNE 28-JULY 1

Give positive polishing action on light contour and radius work where resilient action is necessary.

FLEXIBLE—They mold the belt to the work surely and effectively.

BALANCED—for smooth running, and to give constantly accurate pressure to the working surface. A smoothly ground face assures uniformity.

TWO DEGREES OF DENSITY—one offering greater flexibility, the other more aggressive cutting action . . . both giving pliability and resilience beyond standard contact wheels.

WIDE SIZE RANGE—face widths and diameters for most requirements. Wheel equipped with metal hub. Generally most effective when used with Jeans Cloth (J weight) belts.

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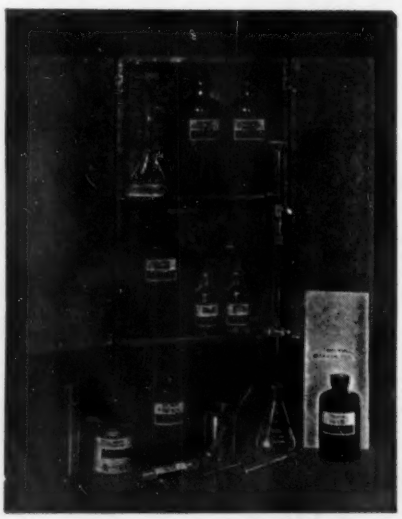

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Write for Literature

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lege who discussed "The Factors that Effect the Form of Electrodeposits."

Dr. A. K. Graham, Exec. Sec'y of the A.E.S., who delivered a paper on "Brass Plating."

Mr. C. E. Nixon, Ternstedt Div., Gen'l Motors, whose talk covered the "Control of Automotive Plating Processes."

While the technical sessions were in progress, a separate program for the entertainment of the Ladies, in the form of a theatre party and afternoon tea took place.

The evening events consisted of the Banquet and Floor Show, both of which were very enjoyable, followed by dancing in the Main Ballroom.

Dr. H. L. Kellner, of the Lea Mfg. Co., was Technical Chairman, and *Mr. Henry A. Strow* headed the General Committee, assisted by *E. V. Collins, Spencer L. Henn, Geo. A. Hisert, Dick Crane, E. W. Luther, Ken Kelley, John Costigan*, and *Mrs. H. A. Strow*.

Twin City Branch

The Twin City Branch of the *American Electroplater's Society* met Monday, May 3rd, 1948, in the Lodge Room of the Covered Wagon in Minneapolis. There were 35 members and guests present.

Al Leonard, Branch President, introduced the following guests: Messrs. *Marty Maher, Frank Weber, Walter Sweet* and *Bruce Jackson*, all of Oakite Products Company, *Mr. Nelson* of Nelson & Nelson, Minneapolis, *Mr. Roy Bierman* of Minneapolis Honeywell, *Mr. Bill Huntley* of National Expert Bait Co., Minneapolis and *Mr. Dean Keller* of Superior Plating, Minneapolis.

Dr. Frank Ireland and *Ben J. Rosenthal*, Convention Display Co-Chairmen gave a report on their Committee and stated that each member would be contacted for their part in the display.

A report on the coming Annual Party to be held June 7th was given by *Hallick B. Johnson*. He mentioned that tickets were now being sold and that there would be the usual excellent prizes, good entertainment and good food.

The Nominating Committee, headed by *Gunnard Deedon*, gave their report of the following persons: President, *Dr. Frank Ireland* of Brown & Bigelow; 1st V. P., *C. A. Bowman* of Minneapolis Honeywell; 2nd V. P., *Mr. Al Joy-*

ner of The Silver Shop; and Secretary-Treasurer, *Robert L. Buckley* of Industrial Chemical & Equipment Co. In addition to the above persons, *Mr. Ralph B. Maddock* of Pako Corp. was nominated from the floor for President. The following officers were elected: *Dr. Frank Ireland*, President; *C. A. Bowman* for 1st V. P.; *Al Joyner* for 2nd V. P., and *Robert L. Buckley* for Secretary-Treasurer.

The Speaker for the May meeting was *Mr. M. Maher* of Oakite Products. His subject was "*The Coloring of Aluminum and its Alloys.*" Mr. Maher's talk was very interesting and informative.

Melbourne (Australia) Branch

At the 31st Regular Meeting of the Melbourne Branch, held on 22nd March, *Mr. J. J. Dale* was unanimously appointed Branch Honorary Secretary and Treasurer. Most of this meeting was occupied in dealing with outstanding business, but time was found for librarian *H. A. Teague* to conduct a short Question Session to which many of the 35 members present made useful contributions.

On 19th April, the 32nd Regular Meeting was attended by 40 members and several visitors. A feature of the business session was the President's announcement that to date this year over 80 food parcels have been despatched from this branch to members of the Electroplaters' Technical Society in Britain.

Our guest speaker on this occasion was *Mr. E. White* whose address on "*Electrotyping and Electroforming*" proved particularly interesting. Mr. White who recently visited both the U.K. and U.S.A. briefly discussed recent technological advances in these fields, but was restricted by time to covering only the broader aspects of modern electrotyping and electroforming. Of great interest were his remarks concerning the relative merits of moulding with lead, wax, or synthetic materials—the lead requiring no pre-treatment, the wax usually being covered first with a fine graphite, and plastics being coated with a silver "envelope," prior to copper or nickel plating. The barrage of questions which greeted Mr. White at the conclusion of his talk was indicative of the enthusiasm which had been aroused in his audience by a breezy, confident delivery of informative subject matter.

10 to 1

You're Paying the Price..Why Not Have Efficient DC Power?

Wagner-Tiedeman Electroplating Rectifiers offer you really efficient DC power, definite advantages, at low all 'round costs. If you get *all* the following features in your present or contemplated power source – it's a Wagner-Tiedeman installation:

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Cells will handle momentary overload up to 1000% of normal. Over 4300 sq. in. effective rectifying area. Three 40-watt cooling fans. Two-winding transformer. 6v at 1500 amp; 12v at 750 amp. Write today for our new engineering memorandum for full specifications and operating details.

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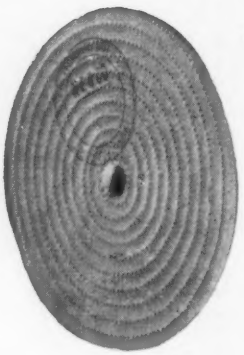
. . . all BUFF through and through!



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B UFFS For Every Type of Work and to Specifications

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"For Over 57 Years—Since 1890 — We Have Been Manufacturing Buffs of Every Description."

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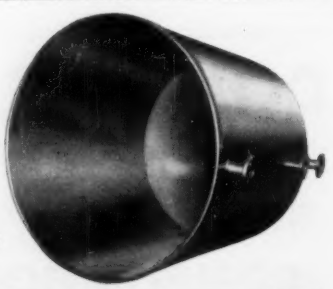

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. . . Involving the handling of acids, alkalis, aromatic solvents, unsaturated vegetable oils, gases, vapors, etc. Engineered recommendations of Laybond Rubber, Hard Rubber, Neoprene, Koroseal, Phenolics or Ceramics. Our specialized applications include racks and hangers, anodes, pickling tanks, drums, pails, dippers, pipe and fittings, air agitation systems, tank grids and screens, coils and ventilation equipment.

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*PORTABLE RIGS FOR FIELD WORK

San Francisco Branch

Election of officers for the 1948-49 term featured the May 13 meeting of San Francisco Branch of the American Electro-Platers' Society.

Jack Hite of the A. A. Plating Co., San Francisco, was elevated from the post of secretary-treasurer to that of branch president. Other officers chosen are: Vice-president, *Fred W. Huntington;* secretary-treasurer, *Fred P. Dartt;* librarian, *Fred W. Huntington.* The new Board of Managers is composed of *Hugh Morgan, Louis Delamoth* and *Mr. Huntington. John Esposito* was named to represent the branch at the national convention in Atlantic City, N. J.

Following the business session, an educational session was held in the form of an open forum discussion on electroplating of stainless steel, and plating with a reversing current switch.

A.S.T.M.

The fifty-first Annual Meeting of the American Society for Testing Materials will be held at the Book-Cadillac Hotel in Detroit on June 21-25. The technical part of the program will feature 19 symposia on various technical subjects, as follows:

Metallography in Color
Usefulness and Limitations of Samples
Magnetic Testing
Deformation of Metals as Related to Forming and Service
Effect of Temperature on Properties of Metals
Corrosion of Ferrous Metals
Tests for Ball Bearing Greases
Waterproofing and Brick
Fatigue of Ferrous Metals
Mineral Aggregates
Corrosion of Pressure Vessels
Speed of Testing
Identifying Reactive Materials
Fuels, Fire Tests, Bldg. Construction
Rubber, Plastics, Mineral Oil, Engine Anti-Freeze
Creep and Fatigue
Cement, Concrete, and Aggregates.

In addition, the usual meeting of the working committees will be conducted, and a Photographic Exhibit of photomicrographic and radiographic pictures. Reservations for rooms should be made well in advance, as a large attendance is anticipated. *Mr. C. M. Gambrill,* 1005 *Stroh Bldg., Detroit,* is the chairman of the Hotel Reservations

Committee. Photographs for the Exhibit should be forwarded to *Mr. H. R. Wolf, Research Laboratories Div., General Motors Corp., P.O. Box* 188, *North End Station, Detroit* 2, *Mich.* Entries must be received before June 14th.

Manufacturers' Literature

Bright Nickel Plating

The McGean Chemical Co., Dept. MF, Cleveland 15, *Ohio.*

The above firm has just issued a new pamphlet describing their Bright Nickel plating process and supplies. Advantages claimed for their process are economy, brightness, simplicity of control, speed, toleration for zinc impurities, and stability of addition agents. Also described and illustrated is their research and control facilities for handling inquiries and production problems.

A copy of this bulletin may be obtained upon request.

Polishing and Grinding Machines

Hammond Machinery Builders, Dept. GP-39, 1600 *Douglas Ave., Kalamazoo, Mich.*

A new catalogue just issued by this firm describes their line of abrasive belt grinding and polishing machines, backstand idlers, and buffing lathes. Both bench and pedestal types are listed, including both horizontal and vertical models. The catalogue is profusely illustrated and shows the innumerable combinations that are possible with the various types of equipment that are produced by this company.

Flexible Metal Tubing

Titeflex, Inc., 546 *Frelinghuysen Ave., Newark* 5, *N. J.*

Titeflex all-metal flexible tubing is illustrated and described in a 24-page catalog recently published by this firm. In addition to Titeflex brass tubing, the catalog describes the company's new bronze tubing for nominal steam pressure applications, monel and stainless steel tubing for higher temperatures and corrosion resistance, and inconel tubing for extremely high temperatures.

Included are specifications for standard fittings and illustrations of

Greetings

to All Conventionites

The Magnuson Products Corporation extends best wishes for the success of the 1948 Convention of The American Electroplaters' Society.

Recent years have been marked by new achievements in the science of metal finishing. Technical knowledge combined with long practical experience of men skilled in this field have brought greater advancement and more rapid progress to individual plants as well as to the society as a whole.

The Magnuson Products Corporation, now in its 25th year of service to the electro plating industry, has long enjoyed the association with this active and expanding business.

1923-1948
OUR 25th YEAR

SUSTAINING MEMBER
A. E. S.

MAGNUSON
PRODUCTS CORPORATION
BROOKLYN 2 N. Y.

CANADIAN PERMAG PRODUCTS, Ltd.
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Buffing and Polishing
COMPOUNDS-

STAND OUT!

To make your products stand out competitively, specify HARRISON cake or liquid compounds. Their fast cutting and quick cleaning action insure economy of operation.

SPECIAL: Harrison has developed a new dip compound that creates a head on the buff. You get a deeper cut . . . use less compound . . . save!

At your request, our experienced technical representatives will call to advise you on special problems.

Cement • Buffs • Buffing and Polishing Compounds
HARRISON & CO., INC. • HAVERHILL, MASS.

typical assemblies with these fittings. The new catalog also describes Titeflex bendable pipe, high frequency conductors, and vibration eliminators.

Conversion Coating for Zinc and Cadmium

United Chromium, Inc., Dept. MF, 51 E. 42nd St., N. Y. 17, N. Y.

Four-page folder on Unichrome Clear Dip describes improved chemical treatment for producing brilliant, corrosion-resistant finish on ordinary zinc or cadmium plate. Folder shows the simple operating cycle of this dipping process, illustrates how it benefits zinc or cadmium, gives general specifications on use. Write for free copy.

Industrial Chemicals

Harshaw Chemical Co., Dept. MF, 1945 East 97th St., Cleveland, Ohio.

A new 32-page bulletin has been published by the above firm that lists all the chemicals manufactured by them, and used by various industries. Harshaw supplies chemicals to nearly 50 different industries, and in addition carries a full line of laboratory apparatus and chemicals of reagent grades. The listing of chemicals is in alphabetical order for easy reference.

Copies of the bulletin are available on request.

Guide to Bright Nickel Plating

The Enequist Chemical Co., Dept. MF, 257 Freeman St., Brooklyn 22, N. Y.

An eleven-page booklet published by this company gives detailed procedures for preparation of the plating bath, cleaning methods, and operating data for their bright nickel plating solution. Also listed are the line of cleaners manufactured by them with instructions for use. A special paragraph is devoted to the plating cycle for jewelry items.

A copy of this booklet may be obtained by writing to the company.

Idler Backstands for Belt Finishing

The *Behr-Manning Div.* of the *Norton Company* has issued a 6 page bulletin describing the advantages and applications of abrasive belt polishing with backstand idler equipment. Information on contact wheels, contour polishing, belt-on-buff polishing, and abrasive belts is included. A copy may be obtained by writing the company.

Industrial Chrome Plating

Chrome Corp. of America, Dept. MF, 120 Broadway, New York 5, N. Y.

A revised catalogue designed to provide helpful information for successful applications of industrial chromium plating is announced by the above firm. The 36-page, profusely illustrated publication outlines the accomplishments of chromium plating, and describes performance that might be expected under known operating conditions. Supplementing the information, research facilities and technical advice are offered by the corporation in solving specific problems of wear and corrosion.

The Crodon plating service of this corporation is widely used in many industrial applications. Description of the characteristics of chromium plating, together with tables and charts complete the catalogue. Copy may be obtained by request.

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featuring—

Removable and Replaceable Work Holders!

REDDY RACK
"Redd-Rack" uses NATIONAL Racks.
The reading glass shows to "Reddy-Rack's" satisfaction, the replaceable work holder features that cuts cost and minimizes rack problems.
NOTE: When comparing savings while using National Racks, glass is not necessary.

WE MAKE THE RACK *YOU* WANT

Insulation makes possible the replacement of worn work holders without injury to the spline section of NATIONAL PLATING RACKS.

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FELT WHEELS ...TOPS IN *Durability*

Even the softest of Felt Wheels offers a durability difficult to match with any other of the commonly used fabric materials. Not only is felt tough and resistant to wear but when wear does occur, the wheel can be re-faced or re-contoured.

The net result of this durability is longer wheel life—longer *useful* wheel life. Try a Paramount Brand Felt Wheel of the proper hardness competitively. Check it against other wheels. We are confident it will show you greater earnings as measured by finished articles per wheel life.

Your Supply House Can Furnish Bacon PARAMOUNT BRAND FELT WHEELS & BOBS

BACON FELT COMPANY

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Fume Separator

An illustrated circular describing the new Niehaus Fume Separator can be obtained from the manufacturer—*Industrial Electroplating Company, Inc., 219 West Vermont Street, Indianapolis 4, Ind.* Typical installations are pictured. Capacities, specifications, and recommended applications all are listed. A cross-section view of the separator shows how it operates by the principles of water absorption and centrifugal separation.

New Air Recovery Handbook

W. B. Connor Engineering Corp., 114 E. 32nd St., New York 16, N. Y.

An engineering and application data book on their Air Recovery equipment which is used in the "recovery" or conversion of stale, vitiated, or contaminated air to its original freshness, either in order to conserve it for re-use or to correct exhaust and intake odor nuisances, has been published by the above firm.

Dorex Type "H" equipment consists essentially of hollow-walled cylindrical canisters containing specially processed activated carbon. It can be installed in a variety of arrangements in ducts or casings to suit different conditions and requirements. Typical assembly arrangements, dimension prints, framing details, capacity and resistance curves are included in the handbook.

Using the same principle as the gas mask—absorption of gases and vapors by activated carbon—air recovery has a host of industrial and commercial applications where a positive means of odor removal is required.

Copies of this new data book may be obtained by request on letterhead for Bulletin 105-A.

Catalog of Scientific Instruments

American Instrument Co., Dept. MF, Silver Spring, Md.

A new catalog, published by the above firm describes numerous scientific instruments for use in chemical, biological, physical, metallurgical, engineering, and materials testing laboratories. The publication is generously illustrated and includes comprehensive data on general laboratory equipment.

The detailed descriptions of hundreds of instruments makes this new Aminco Catalog 48 a valuable guide for the selection of scientific instruments for research, testing, and quality control.

Available free of charge to laboratory workers requesting it on business or professional stationery, giving name, title, business affiliation, and complete address including postal zone number.

New Dust Collector System

Pulverizing Machinery Co., 214 Chatham Rd., Dept. MF, Summit, N. J.

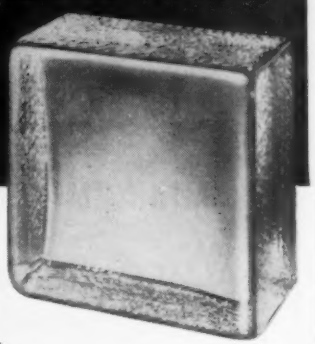
A new illustrated bulletin entitled *"Optimum Recovery with the Mikro-Collector,"* has been announced by the above firm, manufacturers of pulverizers and dust collecting systems.

The features of the new Mikro-Collector for dust collecting are described in detail in text and illustration. Special emphasis is placed on the ability of this equipment to handle even damp and hitherto baffling dust loads.

Better, longer-lasting supports

FOR ACID OR ELECTROLYTIC TANKS

Solid PC Glass Blocks



Because they are impervious to moisture, vapor and the fumes of most common acids, PC Solid Glass Blocks are ideal insulating supports for acid or electrolytic tanks. These solid glass units are non-corrosive and have an ultimate compressive strength of 80,000 lbs. per sq. in. under uniform loading. They have stippled edges and clear faces, one flat and one dished. Dimensions are 5" x 5" x 2⅝". Available for immediate delivery. For complete information, write Pittsburgh Corning Corporation, Room 680-8, 632 Duquesne Way, Pittsburgh 22, Pa.

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by W. P. Fuller & Co. on the Pacific Coast and by Hobbs Glass Ltd. in Canada

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PAINT STRIPPER

A New Development For Industrial Paint Stripping

- Non Inflammable.
- Used Cold.
- Requires No Rinse.
- Works Rapidly on All Types of Finishes.
- Will Not React or Affect Any Metal, Ferrous or Non-Ferrous.
- Non-Injurious to Hands or Clothing.
- Unisol Liquid — For Dipping, Dries Rapidly with no After Film to Interfere with Repainting.

Samples and further information supplied on request.

Chemco Products Company, Inc.

1059 East 76th Street
Chicago 19, Illinois

Parts Cleaning Machine

An attractive new bulletin describing the Klene-ezy parts cleaning machine has been published by the *Cincinnati Cleaning and Finishing Machinery Co., Ironton, O.* The literature describes fully the Klene-ezy method of cleaning parts in metal-working plants and garages and repair shops.

Report on Special Protective Oil

Oakite Products, Inc., 118 *Thames St., Dept. MF, New York, N. Y.*

The above firm has announced the publication of a new Service Report providing helpful data concerning Oakite Special Protective Oil, a specialized material designed to furnish efficient rust-protection of metal parts in production, in storage, or while awaiting shipment.

Oakite Special Protective Oil is a semi-permanent, rust-preventive oil of extremely low viscosity which displaces water, frequently eliminating the necessity of a drying operation, and imparts a thin, protective film to ferrous surfaces, resisting moisture, humidity, perspiration and acid fumes. Metal surfaces treated with this material and subjected to rigid humidity and acid-fume tests, show no evidence of corrosion, it is claimed.

This Service Report provides the latest data available on this specialized rust-preventive material, and incorporates a most interesting flow chart showing strategic points in the production process where Oakite Special Protective Oil supplies effective anti-rust protection. Free copies of this new Service Report are available.

Grinders and Buffers

Globe Products Mfg. Co., Dept. MF, 3380 *Robertson Blvd., Los Angeles, Calif.*

Catalogue # 901 describes and illustrates the Globe line of Autostart grinders and buffers, which were formerly made by U. S. Electrical Motors, Inc. Literature gives engineering data and advantages of this type of equipment.

Catalog of Abrasive Belt Machines

The Porter-Cable Machine Co., 1714 *N. Salina St., Dept. MF, Syracuse* 8, *New York,* has issued a 20 page illustrated miniature catalog describing their complete line of abrasive belt machines, as well as their portable electric tools.

Included in this catalog, which can easily be slipped into the pocket for handy reference, is a description of large abrasive machine tools with automatic feed table, centerless belt grinder, tool room surfacers and smaller bench type abrasive belt models. Backstand idlers are also illustrated. Complete specifications of each machine accompany each description. Applications and economies possible with abrasive belt machines are described.

Corrosion Preventives

Aviation Chemicals Div., R. M. Hollingshead Corp., Dept. MF, Camden, N. J.

A new specification sheet on corrosion preventives has been prepared by the above firm.

This sheet lists various types of corrosion preventives, identifies them by their U.S. Government designations, describes their characteristics, lists their uses, explains the methods of application and removal and, finally, specifies the protection requirements for each type.

Free
Information
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Cleansing and Purifying Zinc Solutions
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Zinc-Brite
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230 Verona Avenue Newark 4, N. J.
BOOTH 69

Water Demineralizers

The Barnstead Still & Sterlizer Co., 161 Lanesville Terrace, Dept. MF, Forest Hills, Boston 31, Mass.

The above firm announces a Bulletin No. 117 describing their new type "R" Upflo Demineralizers. These package units have capacities of from 10 to 100 gallons per hour. The Bulletin illustrates the four models and also gives complete service connection requirements and a chart showing approximate output per cycle for water of from 50 to 500 p.p.m. impurities.

Copies may be obtained by writing the company.

Dust Collector Bulletin

Aget-Detroit Co., Dept. MF, Ann Arbor, Mich.

Typical installations of unit type DUSTKOP dust collectors are illustrated and described in a 4 page bulletin No. 510 titled "Put a Permanent Stop to Dusts" issued by the above firm.

Dust collectors for stopping dusts and lint from grinding, polishing and buffing operations as well as vapor collectors to trap the mist and vapor from thread grinders and centerless grinders are included in the bulletin, together with prices of the units.

Cleaning Aluminum Parts for Spot Welding and Painting

An efficient method of preparing aluminum for spot welding and painting, of protecting finished work against corrosion, and of obtaining smooth, lustrous finished, is fully discussed in a special feature article appearing in a recent issue of Oakite News Service.

The article describes the production procedures employed in a large Eastern plant manufacturing automatic phonographs, where oils, greases, identification marks, fingermarks and oxides must be removed from aluminum parts incorporated in these units before spot welding and painting. Thorough removal of these contaminants from such parts as braces, coin box assemblies, etc., is accomplished by the use of a specialized alkaline material, followed with oxidizing treatment which leaves the material in a state of low and uniform resistance, the article reports.

Aluminum parts are first tank-dipped in alkaline solution at 180 degrees, followed by a cold running rinse. This operation thoroughly removes oils and greases and leaves a slight etch on the work. Parts are next immersed in a deoxidizing solution to remove stains, oxides and discolorations, and to convert the pieces to proper condition for spot welding. A hot rinse then completes this cycle. After spot welding has taken place, parts are again cleaned, deoxidized to remove new soils and oxides which may have accumulated.

Lastly, prior to final organic finishing, phonograph frames in this plant are given a special, phosphate-type conditioning which passivates surfaces so that if any moisture should penetrate the paint bond, it will not react with aluminum to cause corrosion products or gas bubbles which would shorten life of paint coats. Readers interested in obtaining full particulars on materials used, solution concentrations, operating temperatures, etc., may secure free copies of the issue of Oakite News Service in which this article appears by addressing *Oakite Products, Inc., 118 Thames St., New York 6, N. Y.*

4 to 8 Times Normal Speed
Mirror Brightness
Cheaper Than Cd Brighteners

HI-SPEED BRIGHT SILVER

We solicit the opportunity of proving to you that a mere 1% (by volume) of SIL-BRITE added to ANY AGITATED, STANDARD SILVER PLATING SOLUTION will produce these results:

Increase maximum allowable current density from 4 to 8 times the customary value.

Decrease plating time to as little as one eighth.

Produce mirror bright deposits at all current densities.

Eliminate silver buffing.

—And at a cost even LESS than that of ordinary cadmium brighteners.

We are professionally sincere; you will never hear us alibi nor hedge on our statements. Our 15 years of electrochemical experience, days upon days of research, and 10 months of actual production trial, convinces us that SIL-BRITE can give you these results.

Shipped f.o.b. our Cincinnati laboratories:

1 Gallon Cans SIL-BRITE @ $5.75/Gal.
5 Gallon Drums SIL-BRITE @ $5.50/Gal.

ELECTRO-MET RESEARCH ASSOCIATES
P. O. Box 634 Cincinnati, Ohio

For *DEPENDABLE*
and *BETTER* FINISHING QUALITY
call on REEDBURNS for your

Buffing-Polishing Compounds
Buffs and Wheels

- ***Polishing . . .***
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THE HYDROGEN ION

(*Concluded from page 89*)

thalein is discharged, then we can add methyl orange and titrate further to the methyl orange end-point.

At the phenolphthalein end-point reactions 1, 2, and 4 have taken place, while at the methyl orange end-point reactions 3 and 5 have taken place. We may call these Titration A and Titration B.

$$A = \text{all NaOH used} + \tfrac{1}{3}\ Na_3PO_4 \text{ used} + \tfrac{1}{2}\ Na_2CO_3 \text{ used}$$

$$B = \tfrac{1}{3}\ Na_3PO_4 \text{ used} + \tfrac{1}{2}\ Na_2CO_3 \text{ used}$$

$$A - B = NaOH$$

$$A + B = NaOH + 2/3\ Na_3PO_4 + Na_2CO_3$$

The solution may now be boiled to drive off CO_2 and eliminate carbonate. Now alkali may be added to reverse reaction number 3:

$$NaH_2PO_4 + NaOH = Na_2HPO_4 + H_2O$$

This reaction we may call C.

$$C = 1/3\ Na_3PO_4$$

$$2B - 2C = Na_2CO_3$$

$$3C = Na_3PO_4$$

All these components can be determined by this method. The following experiment indicates how they may be determined by use of a pH meter:

A solution of the following composition was titrated with 0.80 normal HCL using a glass electrode:

NaOH	0.20 grams
$Na_3PO_4 \cdot 12\ H_2O$	2.10 grams
Na_2CO_3	.64 grams

The plot of this titration is shown in Figure 10. It can be seen that two breaks in the curve appear at the approximate ranges of the phenolphthalein and methyl orange indicators. From a knowledge of the behavior of these salts and from the curve obtained, it can be concluded that for this electrode a solution containing sodium hydroxide, sodium phosphate and sodium carbonate could be analyzed by titrating to three points: pH 11.3, pH 10.4, and pH 8.5. These points occur at 6.0, 13.5, and 21 ml.

$$6 \times .8 \times .040 = .19 \text{ grams NaOH}$$

$$(13.5 - 6) \times .8 \times .360 = 2.16 \text{ grams } Na_3PO_4 \cdot 12\ H_2O$$

$$(21 - 13.5) \times .8 \times .106 = .64 \text{ grams } Na_2CO_3$$

The glass electrode used for this case was not an electrode recommended for highly alkaline solutions, so the initial pH is in error by more than one pH unit.

References

1. *Trans. Electrochem. Soc. 82* 55 (1942).
2. *Outlines of Theoretical Chemistry*, Getman & Daniels 5th Ed. Pg. 417.
3. *I. C. T. 1* 82.

Correction

In the article on "ANODES—Part II" which appeared in the April issue of *Metal Finishing*, the photo on page 66, Fig. 8 was credited in error to the wrong source. This photo was furnished by the Republic Lead Equipment Co., to whom we are grateful for permission to use it.

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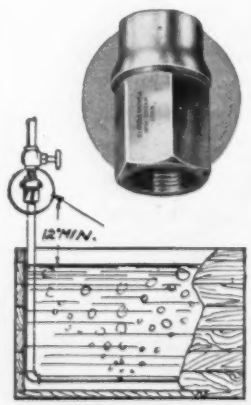

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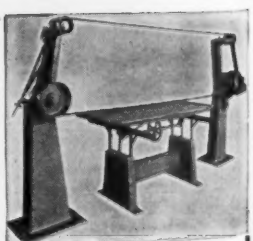

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Letters to the Editor

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Shop Problem Department

Gentlemen:

In response to A. L. S. Problem (Feb. 1948 issue) of rust on steel knives I have found the following procedure effective over a number of years:

Strip knives, polish and buff nickel silver handles.

Wash knives in gasoline or degrease, dry in sawdust, wipe off with clean towel; do not touch blades with bare hands.

Alkali clean (reverse current) two minutes, do not pumice brush.

Cold water rinse.

Dip in straight muriatic acid thirty to sixty seconds.

Cold water rinse.

Steel strike, silver strike, silver plate three to six hours 1-2 volts.

Cold water rinse, boiling water rinse with 1 ounce per gallon sal soda.

Hot water rinse, scratch brush, burnish or whatever finish needed.

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